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HOOPER'S

PHYSICIAN'S VADE MECUM:

A Manual of the Principles and Practice of Physic;

WITH AN OUTLINE OF GENERAL PATHOLOGY, THERAPEUTICS, AND HYGIENE

TENTH EDITION

REVISED BY

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VOLUME I.

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AMERICAN PUBLISHERS' NOTE.

One of the remarkable books in medicine is Hooper's "Physician's Vade Mecum." For over fifty years it has enjoyed the confidence and esteem of the profession; revised and improved from time to time, it has always kept its place in the front rank as a reliable and concise treatise on the practice of medicine. The present issue is reprinted from the tenth English edition, which is fresh from the press, and presents the most advanced and approved views of the subjects of which it treats.

WM. WOOD & CO.,

Publishers.

EDITORS' PREFACE.

The original work of Dr. Hooper, published in 1823, was so successful, and passed through so many editions, as to induce the proprietors to place it in the hands of successive Editors, by whom it was improved and enlarged.

From Dr. Hooper's Preface, it appears that the object he contemplated was to furnish a concise treatise on the practice of medicine for the use of Student and Practitioner. After his death an Introductory Part was added, containing a short outline of Physiology, Pathology, and Therapeutics, some brief directions for Clinical Examination, and a sketch of Symptomatology and Semeiology. This, which did not occupy more than sixty-five pages, was entirely re-written in the first edition entrusted to Dr. Guy, who is largely responsible for the additions and alterations made in this part in all the subsequent editions; while Dr. Harley is now similarly responsible for the matter contained in the second part. Both parts are largely illustrated by wood-engravings, of which several, and those chiefly microscopic, are from original drawings by Dr. Harley. Many old cuts have been replaced by others, and some new ones have been added. The total is now 118.

The general aim and scope of the work is fully explained in the Introduction.

In making the extensive changes and additions above indicated, the original intentions of the Author, to make this work practically useful

to the Student and Practitioner have been strictly adhered to, and we believe it will now be found the most comprehensive work of the kind hitherto published in this country.

Many original observations and practical remarks, embodying the results of Dr. Harley's experience, are contained in the text of the second part. Those contributed by Dr. Guy to former editions are distinguished by the initial G.

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INTRODUCTION.

This book is intended to be, in the largest sense of the term, a practical work; that is to say, it aims at bringing together, in a small compass, and in a form easy of reference, those items of information which the practitioner would wish to possess when he stands at the bedside, or when he studies a case with a view to its treatment.

The first and most obvious requisite for a practitioner is to be able to recognize a disease when he sees it, to distinguish it from others that resemble it, and to foretell its probable course and termination. The treatment he adopts will be judicious in proportion to the certainty with which he recognizes, and the accuracy with which he discriminates, diseases; and will be either rational or empirical, according as he does or does not understand their real nature and true cause.

But there is a vast amount of information of a truly practical character, which does not find a place in formal descriptions of individual diseases. For age, sex, and peculiarity of constitution, original and acquired, give rise to differences in health, or habitual departures from it, which determine the severity, and even modify the character of diseases; and a knowledge of this order of facts is not less essential to safe and successful practice than is a description of diseases themselves.

Again, it often happens that great importance attaches to individual symptoms, and questions occur in relation to them, which cannot be answered in the short space devoted to the description of the disease of which they form a part. They may be common to several diseases, or though assumed to be symptoms of disease, they may be compatible with health. Moreover, there are many symptoms or signs of disease which are detected only by close examination, aided by the use of in-

struments or of chemical tests; in using which many precautions are necessary, not easily borne in mind, and as to which the practitioner may require to refresh his memory.

In the practice of medicine, again, new events and rare combinations constantly present themselves, which can only be understood and successfully encountered by the aid of general principles. Hence the necessity of a knowledge of pathology and therapeutics, as guides in treating obscure cases, or complications of which the physician has no previous experience.

A strong conviction that no man is truly practical who is not also possessed of an extensive scientific knowledge of his profession, has always presided over the preparation of this work, and has induced the Editors to extend it beyond the limits usually assigned to a so-called practical treatise.

In order to carry out these views, this work is divided into two parts, of which the first embraces those facts and general principles that make up the sciences of General Pathology and Therapeutics, while the second contains, in a form easy of reference, a description of diseases, their diagnosis and prognosis, rationale and treatment, or what is usually known as the Theory and Practice of Medicine.

The First Part consists of six chapters, under the following titles: 1. Health and Disease; with an account of their variations under the influence of age, sex, temperament, and mode of life, and explanations of the terms in common use for distinguishing diseases, and giving precision to our views and statements concerning them. 2. Causes of Death: in which some idea is given of the relative frequency and importance of the diseases that prove fatal to human life. 3. Outline of Physiology and General Pathology. In this chapter those facts and theories which bear most directly upon medical practice are briefly stated, more minute details being reserved for, 4. Examination of some of the more important Symptoms and Signs of Disease, comprising the Urine, the Viscera of the Abdomen and of the Chest, the Pulse and the Respiration. Chapter 5 treats of Hygiene, private and public; while chapter 6 contains An Outline of General Therapeutics, as they bear on the preservation and improvement of health and the treatment of disease, with an account of the principal

remedies, and their mode of operation; with a short section on nursing.

The Second Part, or Practice of Medicine, properly so called, is also distributed into chapters, as follows: 1. States of System, as distinguished from diseases properly so called. 2. Local Diseases, affecting all or several of the organs or textures of the body. 3. Febrile Diseases without essential local complication. 4. Febrile Diseases with essential local complication. 5. Febrile Diseases arising from local causes. 6. General Diseases (not febrile), with essential local complications. The remainder of the diseases are distributed into ten chapters, as follows: 1. Diseases of the Nervous System. 2. Diseases of the Organs of Circulation. 3. Diseases of the Organs of Respiration. 4. Diseases of the Organs of Digestion and Abdominal Viscera. 5. Diseases of the Urinary Organs. 6. Diseases of the Organs of Generation. 7. Diseases of the Organs of Sense. 8. Diseases of the Skin and its Appendages. 9. Parasitic Animals; and 10. Poisons, with the Antidotes to the principal poisons.

An extensive collection of Formulæ, preceded by classified lists of the preparations of the British Pharmacopœia, with their doses, is added; and glossarial and general indexes complete the volumes.

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THE PHYSICIAN'S VADE MECUM.

GENERAL PATHOLOGY AND THERAPEUTICS.

CHAPTER I.

HEALTH AND DISEASE.

1. HEALTH may be defined as the integrity of every structure, and the perfect harmonious play of every function of the body; and its ready adaptability to variations in the external conditions of life, such as the temperature, pressure, and moisture of the atmosphere, as well as to changes in the quantity and quality of the food.

2. Perfect health is as rare as extreme old age. Perhaps, indeed, there is but one condition of the body to which the term "health" is applicable; but there may be departures from this standard of perfect health, to which, nevertheless, the terms disorder or disease would be inapplicable.

3. That health is a condition admitting of degrees is shown by the familiar use of such terms as *good, perfect, strong, vigorous, robust, feeble, delicate*—differences generally recognized, not only as belonging to the same person at different times, and at different periods of life, but also as distinguishing one individual from another.

4. But besides these differences in degree there are differences in kind, corresponding more or less to peculiarities of external form and indicating a tendency to particular diseases, or to a peculiar character pertaining to all the diseases to which the person may become subject. These differences are recognized as *Temperaments*—a word wanting in precision, but embodying a useful generalization.

5. Four temperaments are generally recognized—the *sanguine*, the *phlegmatic*, the *bilious*, and the *nervous*.

6. The *sanguine* temperament is characterized by moderate plumpness of person and firmness of flesh. The hair is red or light chestnut, the eyes blue, the complexion fair and florid, the skin soft and thin, the circulation active, the pulse full and frequent, the countenance animated, the movements quick, the passions excitable, the mind volatile and unsteady.

7. The *phlegmatic* or *lymphatic* temperament is distinguished by roundness of form and softness of flesh. The hair is fair, the eyes light blue, gray, or hazel; the skin pale, the lips large, and the face wanting in character and expression. The circulation is languid, the pulse slow, and all the functions, bodily and mental, are torpid.

8. The *bilious* temperament is recognized by firmness of flesh, harsh outlines of the person, and strongly marked and expressive features. The hair and eyes are dark brown or black, and the complexion swarthy. The superficial veins are prominent, and the pulse is full, firm, and of moderate frequency. There is much energy of character, with great power of endurance, physical and mental, and permanence of impressions. When the mind is usually serious and sad, this is called the *melancholic* temperament.

9. The *nervous* temperament is distinguished by a small spare form, with soft and slender muscles. The features are delicate, the hair fair, and the complexion pale or slightly tinged with red; the lips thin, and the eyes light and sparkling. The pulse is small, frequent, and quick, and easily excited by emotion. The senses are acute, the thoughts and movements rapid, and the imagination lively.

10. Pure specimens of these temperaments are rare. In most persons two, or even more, are found combined, and these combinations are known as *mixed* temperaments. In some instances their leading characteristics are so distinct that there is no difficulty in recognizing them; but they may be so blended as to make it hard to say which predominates. Even in the purest specimens we may encounter exceptions to the rule: such as a pulse of 50 in a youth with all the outward marks of the sanguine temperament.

11. Each temperament predisposes to its own class of diseases—the sanguine, to acute inflammation and active hemorrhage; the phlegmatic, to congestion or subacute inflammation, to glandular and tubercular diseases; the bilious, to disorders of the digestive organs and depression of spirits; and the nervous to undue mental excitement.

12. Among the peculiarities of form and appearance, which together constitute the temperaments, there are some that claim attention as indications of strength or weakness. Thus, *cœteris paribus*, the large chest is an indication of vigor, the small chest of weakness; the thin lip, marked features, and small joints, of tone; the thick upper lip, rounded form and features, and large joints, of constitutional debility.

13. Other combinations again prevail among persons subject to certain diseases or classes of disease; and these are known as *Diatheses*. For instance, a fair complexion, fine hair of different shades from light to dark chestnut, a blue or gray eye, and long eyelashes, with a thick upper lip, are frequently found combined in scrofulous persons; and the same combination, with a thin upper lip, is as common in consumptive patients. The one may be termed the *strumous* or *scrofulous*, the other the *phthisical* or *consumptive* diathesis. They are probably the same diathesis slightly modified.

14. The term *diathesis* is also used to designate certain morbid peculiarities; such as the *oxalic*, *lithic*, and *phosphatic diathesis*, applied to persons whose urine yields an excess of oxalate of lime, lithic acid, or phosphoric acid, and their salts, accompanied by other marks of impaired health.

15. These peculiarities which, under the names of temperament and diathesis, distinguish one man from another, may be transmitted from parent to child, and are then said to be due to *Hereditary Predisposition*, or *Heredity*.

16. Hereditary predisposition shows itself in the resemblance of children to their parents or ancestors. Sometimes the very temperament or diathesis of a parent is reproduced, coupled with a close resemblance of form and feature; but generally the resemblance is limited to some strongly marked feature, deformity, or peculiarity of taste, temper, or talent, which may even be transmitted through several generations. Instances have been recognized in the royal families of Europe. In ancient Rome, the mild humanity of the Gracchi, the severity of the Catos, and the cruelty of the Claudian race; in France, the factious rashness of the Guises, and the irritable and unbending character of the family of Mirabeau; and in England, the vigorous intellect of our Gregorys, Herschels, and Pitts, furnish examples of the transmission of virtues, vices, and talents. *Bodily* deformities, such as supernumerary toes and fingers, and malformations of the organs of generation, may be traced to the same source.

17. Hereditary predisposition to disease is also of common occurrence, and in extreme cases all or several children of a marriage become subject, at or about the same age, to a particular disease, such as consumption or apoplexy. The diseases commonly traced to this cause are scrofula, consumption, gout, epilepsy, insanity, cancer, and asthma; and the urinary disorders above referred to (14). Lepra and varicose veins may be added to the list. On the other hand, a sound constitution, and a frame destined to attain an advanced age, are blessings often handed down through several generations.

18. Certain families, again, display a special liability to infectious diseases, such as typhus, scarlatina, whooping-cough, measles, and diphtheria; and an equally special mortality. As several members of a family are often seized with one of these diseases in different epidemics, at long intervals, and in places remote from each other, it is reasonable to suppose that they share a special liability to the disease—that they possess a *family constitution*.

19. Hereditary diseases, as distinguished from hereditary tendencies to disease, are comparatively rare. Few children, for instance, are born with tubercles in the lungs, or with apoplexy.

20. A peculiarity of form, character, or morbid tendency has been known to disappear in one generation, and reappear in the next. This form of hereditary predisposition has been termed *Atavism*.

21. Hereditary diseases or predispositions to disease may be trans-

mitted without any fault or imprudence on the part of parents. But children are often born into the world of infirm constitution and prone to disease, in consequence of circumstances referrible to the marriage of the parents, such as extreme youth or advanced age, great disparity of age, or too close alliance in blood.

22. The habitual state of health of the parents, or even their state of health at the time of conception, and that of the mother during pregnancy, may also determine the constitution of the offspring.

23. Vice is the fruitful parent of disease, not only to the vicious themselves, but also to their innocent offspring, who are usually the greatest sufferers. Thus inherent debility of constitution, and scrofula, with its numerous train of minor disorders, may be traced to syphilis in the parent. The abuse of alcoholic liquors in one generation not unfrequently imposes phthisis, epilepsy, or obesity, on the next. And vice-begotten disease often carries its ravages into succeeding generations.

24. The facts just stated with respect to hereditary predisposition are confirmed by observations on animals, which exhibit its effects not only in their outward form but also in their instincts and habits.

25. Among the morbid states that have been by general consent traced to hereditary taint, the most important is *scrofula.* It consists in an inflammatory deposit in the glands of the neck, or mesentery; in the substance of the lungs, liver, and kidneys; in the membranes of the air-passages, intestines, brain, and spinal cord. This deposit usually breaks down, and leads to important structural changes, resulting in lingering and wasting maladies. It appears to acknowledge as its principal cause a certain weakness and unsoundness of constitution, which, after giving rise to one disease in the parent, may show itself in his offspring in different forms. Thus an epileptic parent may have children afflicted not only with nervous and mental affections, but with scrofula or consumption.

26. From what has been stated concerning temperaments, diatheses, and hereditary predispositions, we may draw this practical inference, that we shall encounter at the bedside a vast variety of constitutions, and many degrees of vigor, by which our treatment of disease must needs be influenced and modified. Hence it is an advantage to a patient that his physician should know his constitution and peculiarities.

27. Temperament, diathesis, and hereditary predisposition, then, constitute the most marked differences between man and man; but there are others of more rare occurrence, and limited to comparatively few individuals, which are known as *Idiosyncrasies.*

28. Of these there are three kinds. The first consists in an extreme susceptibility, or the reverse, to the action of certain medicines; as when one person is salivated by a single small dose of a mild preparation of mercury, while another resists a long course of the same remedy in its strongest form. The second kind consists in the production of poisonous effects by the most common articles of diet; as when fish, fruit, vegetables, and meat, usually accounted perfectly wholesome, occasion marked disor-

der of the digestive organs, accompanied sometimes with cutaneous eruptions. The third class consists in the inversion of the characteristic effects of medicines; as when opium excites instead of soothing, and unusual sleepiness attends the action of common Epsom salts. A class of mental idiosyncrasies might be added, consisting in strange preferences or aversions for objects usually deemed indifferent.

29. The differences arising from temperament, diathesis, hereditary predisposition, and idiosyncrasy, may exist between males or females of the same age; but other and very important differences depend upon sex and age.

30. *Sex.*—The constitution of men differs from that of women, in disease as in health. In the constitution of the male there is more tone and strength, and in the structure of his body more rigidity; hence a greater proneness to inflammatory affections and active hemorrhages; females, on the other hand, have more sensibility and excitability, and a more lax and delicate fibre, with a strong tendency to nervous affections and to diseases of an asthenic character. The functions of menstruation, parturition, and lactation also exercise a marked difference on the health of the female, especially in the production of disorders of the circulation and nervous system.

31. The diseases of men, taken one with another, are more fatal than those of women; men are also more exposed to accident and violence, and more addicted to intemperance. Hence the lower death-rate of females, their greater longevity, and the excess of women among the living population.

32. This difference in the death-rate of males and females obtains at every period of life except the interval from 15 to 35, when the deaths of females are in excess, and the intervals from 5 to 10 and 35 to 45, when the numbers are equal; and it even shows itself in infancy, when sex might be supposed to have least influence, male children under 5 years of age dying at the rate of 73, but female children at the lower rate of 63, in the thousand.

33. The most important practical consideration connected with sex is, the greater liability of males to inflammatory and sthenic diseases, and of females to asthenic and nervous disorders; so that, as a general rule, if a male and female are attacked by the same disease, the former will bear lowering remedies better than the latter.

34. *Age.*—There are several important practical considerations connected with age. In infancy we have to bear in mind the gradual, and often imperfect, establishment of the function of respiration, and the consequent necessity of external warmth; in early childhood the disturbance produced by teething; and throughout infancy and childhood the liability to disorders of the stomach and bowels on the one hand, and of the brain on the other. As the first exposure to contagious diseases usually occurs during the early periods of life, and their *sequelæ* often make a deep and lasting impression on the health, this is another source of modification which ought not to be overlooked. (See, under General Diseases, the fevers and febrile exanthemata.)

35. As childhood passes into youth the disorders of the alimentary canal become less frequent and fatal, and react less severely on the nervous centres.

36. Puberty, which occurs in either sex about the age of 14, entails familiar changes, physical and mental; and, in women, the peculiar function of menstruation. The advent of these changes is often postponed for a few years, during which women are subject to disorders dependent on the imperfect establishment or complete suspension of the menses. Of these disorders anæmia is the most common; but chorea and epilepsy, melancholia, and even mania, attest its occasional influence on the nervous system.

37. The disproportion between the head and abdomen and the rest of the body lessens as age advances; by the twenty-first year the frame assumes its due proportions; and by the twenty-fifth year, or a little later, its full growth. In this period of youth disorders of the nervous system are rare, but febrile and inflammatory affections common; and scrofula, which had shown itself in the form of enlarged glands of the neck, white swellings of the joints, and disease of the mesenteric glands, may now take the modified form of pulmonary consumption.

38. From the twenty-fifth to about the forty-fifth year, the body remains nearly stationary, but with an increasing disposition to corpulence. During the first part of this period, febrile and inflammatory affections and pulmonary consumption are rife; but toward the fiftieth year, congestion and slow degeneration of the tissues of important organs take the place of inflammation, and apoplexy is henceforth a common and rapidly increasing cause of death. In women, the interval from forty to fifty, with the years preceding and following, is marked by the cessation of the menstrual discharge, and the strange nervous affections which often accompany the "change of life."

39. From fifty to sixty years, the body begins to show signs of loss of power and sluggishness of function, the prelude to that slow decay of which the progress is indicated by diminished sensibility, impaired memory, muscular weakness, scanty secretions, calculous affections, osseous deposits, and organic visceral disease.

40. From this enumeration of the diseases prevailing at different ages, it will be inferred that the risks to which life is exposed, as measured by the death-rate, differ considerably. The most fatal period is the first year, during which one-fourth of all the recorded deaths takes place. During the four succeeding years, also, the number of deaths is so considerable that the 25 per cent. of the first year becomes for the first five years 42 per cent. By the completion of the fifteenth year this proportion is increased to nearly one-half. During the forty years from 15 to 55, rather more than a fourth of all the deaths takes place, each decade contributing in nearly equal proportion to the aggregate result. At 55 years three-fourths of the population have succumbed. From 55 to 85, 23 deaths in the hundred, or nearly another fourth, takes place; the ten years from 65 to 75

being the most fatal. Two per cent. of the entire mortality is accounted for by the deaths after 85. A small number of healthy and vigorous persons of either sex reach, or even surpass, the age of 100, and a still smaller number were once thought to have attained or exceeded a century and a half. The following is a condensed view of the distribution of the deaths according to age, when distributed into four equal parts, taking place in unequal times:

Under 1 year,	one-fourth.
1 to 15 (14 years),	one-fourth.
15 to 55 (40 years),	one-fourth.
55 and upward,	one-fourth.

41. These figures show the deaths registered at the several ages; but as the numbers living at each interval of age differ greatly, they do not display the true risk to life. This is shown in the following table, both for males and females.

Out of 1,000 males and 1,000 females living in England at each age, the deaths placed opposite to those ages occur, one year with another, among the English population. The asterisks indicate the intervals of age at which the death-rate is the same in the two sexes—

Ages.	Males.	Females.	Ages.	Males.	Females.
Under 5,	74	63	*35–45,	13	13
*5–10,	9	9	45–55,	19	16
10–15,	5	7	55–65,	32	29
			65–75,	68	61
*5–15,	7	7	75–85,	150	137
15–25,	8	9	85–95,	303	281
25–35,	10	11	*95 and upward,	452	452

42. The figures which represent the rate of mortality of females show a curious approach to regularity of increase in the five decades from 5 to 55, and in the six from 45 to the end of life; the mortality in the first series being nearly as the numbers, 7, 9, 11, 13, 15, while that in the last series is not very remote from the numbers, 15, 30, 60, 120, 240, 480. From the fifteenth to the fifty-fifth year therefore the rate of mortality increases by about 2 in the 1,000 every ten years; and after the fifty-fifth year doubles every ten years.

43. It is important to understand that the same age does not always represent the same degree of growth, or perfection of function. This fact is well illustrated in the female by the variable time of occurrence of the changes indicated by the appearance or cessation of the menstrual discharge. The most usual age for its first appearance is the fifteenth year; but it may happen at any age from eight to twenty-five. In rare instances it has occurred earlier than the eighth year, and, still more rarely, even in the first year of life. So, also, with its cessation. It may happen as early as thirty-five, or even earlier, and as late as fifty-six, or even later; and, after ceasing for a time, may recur at very advanced ages.

44. Another important consideration in regard to age relates to the fatality of the same diseases at different times of life. As age advances, the structure of the vital organs, when damaged by disease, becomes less easy of repair. Hence the diseases of childhood are more amenable to treatment than those of older persons.

45. This general principle is well illustrated by the special case of the deaths by fever. As, in most fatal cases, fever destroys life by setting up inflammation in some important organ, such as the lungs, the bowels, or the brain, the mortality may be expected to keep pace with, and to be a measure of, the liability of the vital organs to become diseased, and to increase as the restorative power diminishes. The calculations of Mr. Finlaison, founded on the experience of the London Fever Hospital, fully confirmed this expectation. If we suppose 100,000 patients to be attacked with fever, at each of the ages specified in the table, the mortality will be that shown in the column of deaths:

Age.	Deaths.
5–16,	8,266
15–26,	11,494
25–36,	17,071
35–46,	21,960
45–56,	30,493
55–66,	40,708
66 and upward,	44,643

The risk to life from fever is, therefore, more than twice as great at 30 as at 10; nearly twice as great at 40, as at 20, and at 60 as at 40; it is nearly five times as great at 60 as at 10, and nearly four times as great above 65 as at 20. Like results have been obtained for the exanthemata, which, like fever, first affect the whole body, but in their progress attack individual organs; for dysentery among troops in unhealthy stations, or under unwholesome circumstances, abroad; and for other fatal maladies.

46. The liability to illness, and its duration, also increase with age. This is shown in the following table, by Mr. Neison, based on a large number of returns from English and Scotch Benefit Societies:

Age.	Percentage sick during each year.	Sickness per annum among those sick in weeks.	Mortality per cent. among the sick.
11–15,	21.9	4.1	1.0
21–25,	22.0	3.8	3.1
31–35,	21.0	4.4	3.8
41–45,	23.0	5.9	4.5
51–55,	27.6	8.5	6.2
61–65,	35.6	15.2	8.6
71–75,	58.4	32.3	12.1
81–85,	74.5	37.8	18.4

47. The differences due to temperament, diathesis, hereditary predisposition, sex, and age are still further extended and increased by *Air and Climate, Place of Abode, Supplies of Food and Water, Occupation, Habits, and Mode of Life.*

48. The most powerful of these influences is the atmosphere, which not only affects the body by variations in its temperature, pressure, moisture, and electric condition, but by its contact with the skin and internal surface of the lungs, produces the most important chemical changes in the blood. Several subtle poisons, of which some spring from inorganic matter, others from the decomposition of animals and vegetables, and others from diseased living bodies, are also held suspended in the air, and, when concentrated, cause fatal accidents or severe diseases; but when diffused in smaller quantity, weaken the body and impair the health. Smoke, dust, and metallic particles, resulting from chemical or mechanical operations, also impair the functions of the skin and lungs, and lay the foundations of disease.

49. The temperature, moisture, pressure, and electric state of the air, modified and blended by situation, soil, and the conformation of the surrounding country, constitute *climate*, of which the prolonged effect on the frame is seen in the form and features, as well as in the condition of the several functions of the body. Some of these conditions deserve a separate notice.

50. *Temperature* is by far the most important; for it has been well ascertained that in temperate climates sickness increases as the temperature rises, while the mortality is greatest when the thermometer is very low; so that a hot summer and a cold winter are both very fatal to life. The summer diseases are diarrhœa, cholera, dysentery, and enteric fever, among the young and middle-aged; in winter, pneumonia and bronchitis are rife, and are very destructive to infants and aged persons. As a high temperature promotes putrefaction, it is favorable to diseases dependent on atmospheric impurity. Hence, in former times, when towns and houses were in a very uncleanly state, sickness and mortality were both at their height in summer; and one result of their improved sanitary condition is to shift the maximum mortality from the summer to the winter months.

51. The influence of temperature on the occurrence of fatal maladies is best shown by the following table, in which the months are thrown into three groups of cold, hot, and temperate. The following are the death-rates for London:

	Deaths.
Four cold months (December, January, February, March), .	21
Four hot months (June, July, August, September), . . .	19
Four temperate months (April, May, October, November, .	18

From this table it appears that the coldest months are most fatal, while the hot months rank next in fatality, those of intermediate temperature being the least fatal.

52. The fatal effect of cold, first distinctly pointed out by the younger Heberden, is strikingly shown by a comparison made by Dr. William Farr, between the deaths in ten consecutive cold days in November and December, 1856, and ten warmer days preceding and following them. The ten cold days had a mean daily temperature of 34°, and a mean nightly temperature of 27°; the ten warm days a mean daily temperature of 51°, and a mean nightly temperature of 47°. The results are shown in the annexed table.

	Ten colder days.	Ten warmer days.
Consumption,	232	163
Bronchitis, pneumonia, and other diseases of the lungs,	502	394
Diseases of the heart,	73	51
Diseases of the brain,	170	172
Other diseases,	867	725

In consumption, bronchitis, and other diseases of the lungs, and in heart disease, therefore, a fall of about 20 degrees of temperature caused the deaths to rise in the ratios of 16 to 23, 39 to 50, and 51 to 73; while the total deaths in the colder were to the total deaths in the warmer days as 18 to 15.

53. The influence of temperature in promoting disease is most distinctly displayed in the inhabitants of temperate climates, after long residence in either the torrid or frigid zones, especially if, as often happens, they do not adapt their mode of life to the climate.

54. The temperature in different parts of the world also contributes largely to modify the diseases of the natives themselves. The countries within and adjacent to the tropics are severely scourged by intermittent, remittent, and yellow fever, diarrhœa, dysentery, and cholera, and diseases of the liver; while the countries verging on the North Pole are the homes of catarrhal affections, influenza, diseases of the organs of respiration, and scurvy; and the countries in the temperate zone, between the tropics and the poles, of fevers of the continued type, typhus and enteric, with intermittent and remittent fevers of a more tractable character, consumption, rheumatism, and cutaneous diseases of great variety, and often of great severity.

55. The diseases proper to the several regions of the globe also prevail in countries which share with them a singular temperature; so that isothermal lines, or lines of equal temperature, are lines also of equal or similar disease. Thus the diseases incident to countries in or near the tropics prevail along the equator of heat, or mean annual isothermal line of 82.4° Fahr.; and in and near all that zone or region which is bounded north and south by the isothermal line of 68°; while the diseases of the temperate zone occur in the countries lying on or near the isothermal line of 50°; and those of the polar zone or region on or near the isothermal line of 41°.

It may be useful to trace the course of these three isothermal lines, and to mention the countries or cities which they traverse or touch :

1. The isothermal line of maximum temperature, or equator of heat (82.4° Fahr.), traverses, or passes near, the southern coast of the Gulf of Mexico, the Gulf of Guinea, the Straits of Bab-el-Mandeb, and the fortress of Aden, the southern point of Hindostan and the city of Madras, and the islands of Sumatra and Java.

2. The northern isothermal line of 68° traverses California, skirts the north coast of the Gulf of Mexico, touches Madeira, the fortress of Gibraltar and the city of Algiers, follows the south coast of the Mediterranean, and passes through China at the latitude of Nankin. The southern line traverses South America from Potosi to Santa Fé, touches the Cape of Good Hope, and cuts off that southern portion of Australia which has become the home of English colonists.

3. The northern isothermal line of 50° touches New York and the southern point of Ireland, traverses the north coast of the Black Sea, Caspian, and sea of Aral, and passes between the northern and southern islands of Japan. The southern line traverses the southern point of South America, runs north of the Falkland Islands and south of Van Diemen's Land, and cuts off the southern angle of New Zealand.

4. The isothermal line of 41° touches Quebec, the south coast of Iceland, Stockholm, and Moscow, cuts in half the northern island of Japan, and runs south of the peninsula of Kamtschatka.

56. With regard to these isothermal lines, it should, however, be borne in mind that the diseases incident to the several zones may pass beyond the limits assigned to them, whenever, from local causes, the mean temperature is raised or lowered, when the summer is unusually hot or the winter unusually cold. In the one case, the diseases of the temperate zone may assume a character allied to those of the tropics ; in the other, they may approach closely to those that prevail among nations nearer the pole.

57. But the diseases that prevail in the several zones must not be attributed wholly to temperature. Thus scurvy, which is very prevalent and fatal in the polar zone, may be traced in part to cold, and in part to the imperfect diet which is its result—a diet which would occasion scurvy in any part of the world. Nor are the fatal diseases of the tropical zone due solely to a high temperature ; for they are partly caused by heat acting on and developing the miasma of damp and rank soils. Hence troops encamped on dry spots in the most unhealthy tropical districts may escape, to a great extent, the prevailing maladies ; and it is by the discovery and occupation of such spots that the inhabitants of temperate climates maintain their possessions in countries having a much higher temperature than their own.

58. The influence of *moisture*, as distinct from that of the emanations it promotes, is not so easy to trace. There is reason, however, to believe that the inhabitants of damp soils and low-lying districts have less vigor, and are more liable to pulmonary consumption, than those of gravelly and

sandy soils and the summits of hills and mountains. Many invalids suffer most when the air is loaded with moisture.

59. It is also a notorious fact that excessive humidity coexists with a high temperature in regions most fatal to human life; as on the south coast of Africa, the Sunderbunds of Bengal, and the deltas of rivers, marshes, and jungles, in and near the tropics. In more temperate regions the same combination of moisture with heat proves fatal to life during summer. But in both cases the unhealthy influence is probably due to the bad drainage which naturally exists in such situations, rather than to excess of moisture.

60. *Atmospheric pressure* has also its effect on health, and many invalids suffer even from slight changes in this respect. The oppression experienced in the diving-bell, the diarrhœa which attacks travellers on their arrival in very lofty situations, and the hurried respiration, quickened circulation, and hemorrhagic tendency brought on by the ascent of high mountains, are illustrations of its more extreme effects.

61. The influence on health of the *electric condition* of the air is shown by the headache and other uneasy sensations experienced by many persons before a thunderstorm.

62. The quantity of *ozone* (a modification of oxygen caused by repeated electrical discharges, and characterized by a peculiar odor and increased power of oxidation) bears some relation to the prevalence of certain diseases. Thus during attacks of intermittent fever and of cholera the air has been nearly free from it, and during at least one epidemic of influenza it was noted to be in excess.

63. But there are other atmospheric changes known to us only by their effects. Asiatic cholera, for instance, has, on four occasions, overstepped its usual limits, and spread over the greater parts of the habitable globe; and the entire class of infectious and contagious diseases exhibits variations in intensity from year to year, which cannot be explained by differences of temperature, moisture, and pressure, nor even by variations in the electric state of the air, and in the proportion of ozone. We are forced, therefore, to believe in the concurrence of some of these external agencies with certain local conditions, of which the chief may be safely assumed to be imperfect drainage and consequent contamination of drinking-water. Other causes at present unknown and unsuspected may hereafter be found to account for those changes of character which certain prevalent diseases have been observed to undergo from year to year and season to season—changes attributed by the older writers to what they termed the *epidemic constitution* of the air.

64. We may form some idea of the influence of these concurrent conditions by noting the annual fluctuations in the number of deaths from contagious disease. Thus in the fifteen years from 1840 to 1854, the deaths from typhus and enteric fever sank as low as 615, and rose as high as 1,600; from erysipelas, as low as 113, and as high as 260; from whooping-cough, as low as 582, and as high as 1,217; from measles, as low as

249, and as high as 1,122 ; from scarlet fever, as low as 354, and as high as 2,132 ; from small-pox, as low as 87, and as high as 890 ; and from influenza, as low as 35, and as high as 562. These are the deaths that took place in London in a million inhabitants in the years and from the causes specified. It will be seen that while the deaths from fever, erysipelas, and whooping-cough fluctuated nearly as the numbers 1 and 2, those from measles varied as nearly 1 and 5, from scarlet fever as 1 and 6, from small-pox as 1 and 10 ; while the deaths from influenza were 16 times as numerous one year as another. The deaths from small-pox have been subject to a high rate of fluctuation both before and since the practice of inoculation and vaccination.

65. These variations will appear the more remarkable if we contrast them with the slight annual fluctuations in the rate of mortality of many other diseases, especially of those which consist in structural change. The deaths from pulmonary consumption, for instance, in the same years and among the same number of persons, fluctuated between 2,645 and 3,941 ; pneumonia, between 1,340 and 2,169 ; from cancer, between 253 and 432 ; and from apoplexy, between 264 and 607.

66. A still more vivid idea of the annual fluctuation in diseases of the contagious class is afforded by the fact that no combination of causes within or beyond human control—neither the weather, nor shipwrecks, nor the imports and exports of commodities, nor prices, nor the funds—is subject to such fluctuations from year to year.

67. It is also worthy of remark that the several diseases of this class are not all epidemic in the same years ; for the smallest number of deaths from small-pox, erysipelas, and measles, and the largest from small-pox and influenza, occurred in years in which no other of the diseases specified in § 64 attained their highest or lowest numbers ; while the least number of deaths from influenza coincided with the greater number from measles ; and the lowest from typhus fever with the highest from whooping-cough. It is true that the least mortality from scarlet fever and typhus coincided in the year 1841, and the greatest from scarlet fever, typhus, and erysipelas, in 1848. But the epidemic visitations of cholera occurred in years marked by no peculiar excess or defect of any of these diseases.[1]

68. Epidemic diseases often appear to precede, supersede, to run into, or even, to some extent, to supplant each other ; so as almost to justify the belief that they arise out of the same conditions, the particular disease prevailing in any one locality being determined by slight variations in those conditions. Cholera, enteric fever, and the worst forms of intermittent fever are probably due to the same general conditions thus slightly varied.

69. *Contamination of the air* is a most efficient cause of impaired health, as well as a prolific source of disease. The air is made impure in rural districts by exhalations from stagnant pools and marshes, and from col-

[1] See Dr. Guy's two papers in Statistical Journal, years 1855 and 1857.

lections of manure ; in large towns by the decomposition of animal and vegetable substances, the refuse of manufactories, the smoke due to the imperfect combustion of fuel, and the dust created by constant traffic.

70. These impurities in the air of large towns, existing within and without the dwellings of their inhabitants, modify the health of those otherwise healthy, and make them liable to diseases distinguished from those of rural districts by an absence of power or tone ; so that a disease which in the country would bear, if it did not require, bloodletting, would, in a large town, scarcely admit of depletion, and might even demand an opposite treatment. This depressing effect of the air of large towns, displayed in the pallid aspect of those who are deemed healthy, and in the want of power accompanying their disease, is a fact necessary to be borne in mind at the bedside.

71. A residence in large towns makes itself most felt in such of the inhabitants as work within doors, and who inhale both the impure air of the town itself, and the close heated atmosphere of shops and workshops, often in the absence of the wholesome stimulus of light. These persons exhibit, in an extreme degree, the influence of a town life, and their diseases are most distinctly marked by want of power. So that the indoor and outdoor laborers of large towns differ from each other as much as the inhabitants of town and country. A less marked difference is observable between those who work within doors, with little and with more exertion.

72. Many persons who follow indoor employments are further exposed to the exhausting influence of long hours of work or service, often extending far into the night, and even usurping almost all the time that should be devoted to sleep. The London bakers during the whole year, compositors (and, it is to be feared, many successful men in all trades and professions) during the session of Parliament, members of Parliament themselves, and milliners and dressmakers in the fashionable season, suffer greatly from this cause.

73. The injurious influence of the causes just specified may be inferred from the excessive mortality which prevails in large towns. Thus, while the annual mortality of rural districts varies from 18 to 22 in the thousand, that of town districts, not being seats of manufacture, will often amount to 25 ; and that of populous manufacturing towns and crowded seaports to 35 or more. The deaths in some continental capitals exceed 40 in the thousand, and the highest of these rates is exceeded in the worst districts of almost all our large towns.

74. These figures represent the number dying compared with the number living. When the ages of the living are taken into account, these differences are brought within narrower limits ; but their relation to each other is not materially affected.

75. It must not, however, be supposed that the rural districts enjoy an immunity from the causes which impair vigor and shorten life in towns. Bad drainage and obstacles to the free movement of the external air often combine with overcrowding and neglect of cleanliness within doors, and a

scanty and unwholesome diet, to counteract the wholesome influence of labor in the open air, and to predispose to diseases of the low type prevalent in crowded city populations. Nor is overwork an evil limited to town populations.

76. The country may also share with the least healthy parts of our large towns the evil of a rich and ill-drained soil. Many a small village, or isolated country house, like the old town of Liverpool, stands on a swamp, catching the water from higher ground; and inviting a visit from every pestilence.

77. The diseases which cause the high mortality of town populations are, in accordance with what has just been stated, the scrofulous affections of children, and pulmonary consumption in the adult, together with febrile diseases and the exanthemata. Dusty occupations, such as those of the miller, the potter, and the collier, also give rise to diseases of the lungs, which exist in their most severe and fatal form among the scythe, knife, and needle grinders of Sheffield.

78. Next to impure air and unwholesome residences, as causes of debility, comes scanty or unwholesome food. Insufficient nourishment is a chief cause of that want of power and tone which marks the inhabitants of large towns, and of some of our least favored rural districts. In infancy and childhood, again, a diet not merely unequal to the wants of the frame, but unsuitable to the age, or destitute of some essential element of growth, often sows the seeds of future weakness and disease. At all ages, too, the poor either consume unwholesome food, or live on a diet wanting in the requisite variety of elements: hence land scurvy and other allied diseases. Hence, also, in earlier periods of our history, that scorbutic state of the mass of the population, which, co-operating with fevers, plague, and small-pox, gave rise to a destruction of human life of which we have happily no experience.

79. Water supplied in quantities insufficient for cleanliness, or of a quality unfit for drinking, is also among the recognized causes of impaired health and actual disease. Water may also become the vehicle for the poison of lead, and as recent experience has shown, of animal poisons thrown off from the body itself. Hence the part it bears in the propagation of enteric fever, dysentery, and cholera. Recent painful experiences have also taught us that the poison of scarlet and enteric fever may be carried in milk, and so become the source of many and fatal attacks of those diseases.

80. Another cause of weakness and disease is the abuse of spirituous liquors, showing itself in the pallid and sodden aspect of the drunkard, in the fatal effects so often attending the slightest injuries in brewers' draymen and other intemperate persons, in many forms of disease, and in the shortening of life. Its power of shortening life is shown by such facts as the following:

81. In men peculiarly exposed to the temptation of drinking, the mortality before thirty-five years of age is twice as great as in men following

similar occupations, but less liable to fall into this fatal habit; and the rate of mortality among persons addicted to intemperance is more than three times as great as in the population at large. At the earlier periods of life the disproportion is still greater, being five times as great between 20 and 30, and four times as great between 30 and 50. The annual destruction of life among persons of decidedly intemperate habits has been estimated at upward of 3,000 males and nearly 700 females, in a population of nearly 54,000 males and upward of 11,000 females addicted to intemperance. Most of these deaths are due to delirium tremens and disease of the brain, or to dropsical affections supervening on disease of the liver and kidneys.

82. This extensive prevalence of intemperance in England should be borne in mind, especially as no fact is better established than the great danger of treating the diseases of intemperate persons by depletion or lowering remedies. The same remarks apply in a less degree to tobacco, chewed or smoked. But the very general union of drinking and smoking, and the fact that, up to this time, no special structural disease has been traced to the excessive use of tobacco, obliges us to speak with some hesitation on this subject.

83. Luxury, too, like intemperance, tends to undermine health and shorten life. Hence the higher orders are short lived, and we may therefore safely infer, unhealthy while they live. Our agricultural laborers, in spite of their many disadvantages, live much longer; and the aristocracy are nearly on a par with the members of benefit societies in Liverpool, the unhealthiest city in England. Of the classes, too, which enjoy the most ample means of self-indulgence, those are most healthy who are least tempted. Thus the gentry are longer lived than the aristocracy; the aristocracy than the members of royal houses; and these last than crowned heads. Those who occupy the highest place in the social scale are probably, in point of health and longevity, but little raised above the very meanest of their subjects. In wealthy communities persons who have no occupation of sufficient importance to interest and occupy the mind always abound. They constitute a large proportion of the class of habitual invalids, and those among them who have retired from a life of active exertion appear to be the greatest sufferers.

84. But while the unfortunate possession of wealth unpurchased by exertion tempts young men to sloth, luxury, and dissipation, and older men to less active self-indulgence, other classes are exposed to similar evils. The soldier, in time of peace, suffers from the *ennui* of insufficient employment, is strongly tempted to indulge in dissipation, and is exposed, at the same time, to the evils of overcrowded and unwholesome barracks. Confinement, and the absence of employment calculated to interest and excite the mind, also undermine the health of prisoners and paupers. Recent inquiries have proved that the life of the soldier in time of peace is shortened by the causes now specified, and that the perfect sanitary arrangements of our prisons barely suffice to place their inmates on a level

with the community at large; and it is highly probable that for every life which poor-laws have saved by averting starvation, a hundred have been sacrificed by the imprisonment they inflict, and the contagious maladies they promote. It is also probable that the self-imposed sloth of the wilfully destitute is as fatal as the involuntary privations of honest poverty.

85. The enumeration of the causes of the wide differences existing between individuals reputed healthy, would be incomplete if no notice were taken of that strange and inexplicable change wrought in the body by contagious or infectious maladies, and especially by the febrile exanthemata, which confer an immunity from, or greatly diminished liability to, a second attack of those diseases. A similar result is brought about in one instance by a disease nearly allied to, but not identical with, the disorder from which the body is protected—by vaccination as a preventive of small-pox.

86. Nor should we pass unnoticed a fact most important in its bearing, both on the treatment of disease and the expectations we form of its success, namely, the existence of *latent disease* of the lungs, heart, liver, or kidneys. These organs, which seemed to perform their functions well, so long as they were not exposed to any unusual strain, may prove quite unequal to the task imposed upon them by the congestion which attends febrile and inflammatory disorders. When the function of either of these organs is greatly hindered or suspended, the blood becomes charged with a poison which the frame, already diseased, is powerless to eliminate.

87. The foregoing considerations respecting health, and the differences that exist between one individual and another, may be thus summed up: There are many original and many acquired differences between man and man. The original differences are those conveyed by the terms Temperament, Diathesis, Hereditary Predisposition, and Idiosyncrasy; to which we may add those dependent on Sex and Age. The acquired differences are due to Air and Climate, Place of Abode, supplies of Food and Water, Habits, Occupation, and Mode of Life; and, in certain instances, to diseases previously undergone or to others latent in the system.

88. When, therefore, we take into consideration the original differences between individuals, and the various and complicated influences to which they are exposed in all states of society, but especially in highly civilized communities, no additional argument will be needed to establish the first great principle on which the practice of medicine hinges—*that in health, and consequently in disease, every function of the body varies greatly in different persons.* This fact is the key to the imperfection of Medicine as a Science and its difficulty as an Art.

89. Disease.—To define disease we must first have defined health, for the one is but the negation of the other. In like manner, the description and right understanding of disease depend upon the description and right understanding of health. Without attempting a formal definition, it will suffice to state, that disease is present when any structure of the body is changed (provided that change be not the direct and immediate effect of

external injury), or when any function is either unnaturally active, or torpid, or altered in character.

90. There is one important practical distinction which may be properly insisted upon in this place: a distinction between disease, structural or functional, and those unhealthy *states of system* brought about by the prolonged operation of the causes enumerated in §§ 69–86. Previously to the invasion of any well-defined disease, the constitution may have been brought, by the continued action of one or more of these causes, into a state which shall make the disease itself assume a more or less severe form, and even to depart in some respect from its usual character and course. Success in practice depends as much on the prompt recognition of these *States of System*, as on the individual peculiarities pointed out in §§ 4–46.

91. Diseases vary very much in their (*a*) nature; (*b*) form of type; (*c*) course and duration; (*d*) terminations; and (*e*) mode of occurrence. Under these heads certain terms in common use will now be explained.

(*a*) *Structural.*—Consisting in alteration of structure.

Functional.—Consisting in disordered action.

Common.—Presenting the usual characters of common inflammation, etc.

Specific.—Peculiar, or departing from the common character.

Malignant.—Diseased growths for which no remedy has yet been discovered, and which spread from texture to texture: such as cancer. Also diseases which assume a very dangerous and intractable character; such as malignant cholera, malignant typhus, malignant scarlatina.

Idiopathic.—Not dependent upon any other disease.

Symptomatic.—Dependent upon, or being a symptom of, some other disease; as dropsy following disease of the heart, liver, or kidneys.

Primary.—The first in a succession of diseased conditions: for instance, a primary venereal sore.

Secondary.—Following after or upon some other disease; as secondary syphilis.

92. (*b*) *Continued.*—Running their course without interruption in their symptoms.

Intermittent or *Periodical.*—Interrupted by intervals of health.

Remittent.—Having an alternate increase or decrease, but no complete cessation of symptoms.

93. (*c*) *Acute.*—Of short duration and great severity.

Chronic.—Of long duration and slight severity.

These may be combined, as in ague, which is *chronic* in duration, *acute* in severity; or they may run into each other, the acute subsiding into the chronic, and the chronic being heightened into the acute. The terms *acute* and *chronic* have also been used to indicate degrees of severity; as when rheumatism of the joints is called *acute* rheumatism, or rheumatic fever, and rheumatism of the muscles *chronic* rheumatism.

Sthenic.—Marked by vigor and excitement; nearly synonymous with acute.

Asthenic.—Characterized by want of vigor, and nearly synonymous with *typhus* and *adynamic*.

94. (*d*) Most diseases end in complete, many in partial or incomplete, recovery.

Recovery is generally gradual, but in certain cases the transition from disease to health is rapid and even sudden. The interval between the subsidence of the disease and the restoration to health is termed *convalescence*. If, during this period, the disease returns, the patient is said to suffer a relapse ; and this is so common an occurrence in one form of continued fever that it has been called *relapsing fever*.

The diseases from which the recovery is slow, are mostly those that exhaust the patient's strength by their severity or long duration ; such as fevers, acute inflammation, exhausting discharges, and paralytic affections. The diseases from which recovery is sudden or rapid are for the most dependent on mechanical causes, such as calculi in the gall-duct or ureter. Neuralgia also frequently passes off suddenly, and returns with as little warning.

Sometimes diseases terminate suddenly by profuse discharges, eruptions, or external inflammations. Such events are called *critical*, or they are called *crises*. Observation, both ancient and modern, seems always to have proved the existence of *critical days* : that is to say, days on which febrile disorders are prone to take a favorable turn.

Local affections may also be said to terminate by *metastasis*, or transference from the part first attacked to some other, as from the joints to the stomach, heart, or brain, in gout ; or by extension to a texture similar to the one originally attacked, as when acute rheumatism having commenced in the fibrous textures surrounding the large joints, seizes upon those in and about the heart.

95. (*e*) *Contagious and Infectious.*—Both these terms are now used to designate diseases communicable from one person to another ; the first by contact, the second by being conveyed in the air.

Epidemic.—Attacking a number of persons at the same time, and recurring at irregular intervals ; as fever and small-pox. Some of these diseases, as cholera and influenza, spread with great rapidity, and attack at or about the same time the inhabitants of whole continents.

Endemic.—Peculiar to certain localities, as ague, goitre, elephantiasis, etc. The same disease may be both epidemic and endemic : thus, typhus, which is endemic in certain districts of large towns, becomes epidemic in those districts in certain seasons or years ; cholera, again, which is endemic in parts of India, may become epidemic in other parts of the same continent, and in Europe.

Sporadic.—This term is applied to epidemic and endemic diseases when they attack one or two persons only, in which case they are said to occur *sporadically*. Such attacks are common at the beginning and end of epidemics.

Zymotic.—This term, derived from a Greek word signifying ferment, is

now applied to the entire class of epidemic, endemic, and contagious diseases. It is convenient as grouping together diseases allied to each other by similarity of cause, but objectionable as based upon a mere hypothesis obviously inapplicable to cases of sudden death due to the operation of atmospheric and other poisons.

96. *Names of Diseases.* (Medical nomenclature.)—No uniform plan has hitherto been adopted in giving names to diseases. The greater number have been named from some prominent symptom, as fever (from *ferveo*, to burn), hydrophobia, diabetes; others from their seat and nature combined, as hydrocephalus (water on the brain), or the seat is indicated by the root, and the nature of the disease by a common termination. Thus, the words pericard*itis*, pleur*itis*, ir*itis*, mean inflammation of the pericardium, of the pleura, of the iris. Words in common use have also been superseded by terms descriptive of the seat or nature of the disease: as *enteric* in lieu of *typhoid* fever; and *hyperæmia* (excess of blood), qualified by the words general, local, active, and passive, for plethora, inflammation, and congestion, and *anæmia*, similarly qualified, in place of chlorosis.

97. *Classification of Diseases.* (Nosology.)—It is not easy to devise a nosology resting on a sound scientific base; but for men engaged in learning, teaching, or practising medicine, that arrangement is best which classifies diseases according to their nature, when that is sufficiently ascertained, and in other cases according to the part of the body which they attack; just as for state purposes that nosological system is to be preferred which places most prominently before the public, as a distinct class, the diseases admitting of prevention or mitigation by sound sanitary measures. In this point of view, the classification adopted by the Registrar-General deserves commendation. A very complete classified list, comprising diseases, general and local; poisons and injuries; with an appendix of surgical operations, human parasites, and congenital malformations, has also been put forth by the College of Physicians.

98. There are some general considerations connected with disease of far higher importance than the use of terms, or the adoption of a correct nomenclature and scientific classification. These will be treated under the following heads: (*a*) Causes; (*b*) Symptoms and Signs; (*c*) Diagnosis; (*d*) Prognosis; and (*e*) Treatment.

99. (*a*) *Causes of Disease.* (Etiology.)—The causes of disease may be conveniently divided into *proximate* and *remote.*

Proximate Causes. (Causæ abditæ, continentes, occult causes.)—This term has arisen out of the twofold meaning of the word disease. When it is named from the part it attacks, and the nature of the change that part is undergoing, as pericarditis, or inflammation of the pericardium, the proximate cause is the disease itself; but if the name is the representative of a group of symptoms, as cough, dyspnœa, hectic fever, emaciation, etc., the symptoms of pulmonary consumption—then the term proximate cause means the suppurating tubercle which gives rise to all these symptoms. If we are ignorant of the seat of a disease, as is the

case with fever, the search after a proximate cause is but an inquiry into its real nature.

Remote Causes. (Causæ evidentes.)—All constant antecedents of an event are called *causes* of that event, and all constant consequences are called *effects.* Hence the same thing may have many causes. Thus, an hereditary tendency, intemperance, or want, and a common cold, may unite in the same person as causes of pulmonary consumption. The tendency may have rendered the person liable to tubercle; intemperance or want may have occasioned its actual deposition, and the cold may have excited it into activity. All these are *causes* of consumption, and the consumption may become the cause of death. How, then, are such causes to be distinguished from each other? They are divided into *predisposing* and *exciting.* In this instance, the *predisposing* causes are the hereditary tendency and the mode of life; the *exciting* cause is the cold; and the *proximate* cause (if the term need be used) the suppurating lung.

The condition of the body itself, however brought about, is the *predisposing cause* of any disease which may befall it; the *exciting causes* are, for the most part, external agents, such as cold and heat; these are also among the most powerful *predisposing* causes. Thus, that combination which we call climate is the predisposing cause of a great variety of diseases; and any one of the elements of which it consists may become an exciting cause.

Some of the principal predisposing causes of disease have been already considered (§§ 4–86) when speaking of temperament diathesis, hereditary predisposition, and idiosyncrasy: of sex, age, occupation, and mode of life; of residence and climate. The local or constitutional injuries which attend severe illness are also causes predisposing to fresh attacks of the same disease.

The exciting causes of disease are chiefly mechanical and chemical injuries, unwholesome food, undue exertion of mind or body, sudden and violent atmospheric changes, parasitic animals and plants, atmospheric poisons, poisons generated by the human body itself, and those of venomous insects, reptiles, and mammalia.

100. (*b*) *Symptoms and Signs of Disease.* (Symptomatology, semeiotics.)—All lesions of structure, whether from external injury or from internal change, cause some disorder in the functions of the body, and almost every disorder of one function leads to derangement in those most closely connected with it. These disordered functions are called *symptoms.* Thus, redness, swelling, heat, and pain are symptoms of inflammation; and fever, which is itself recognized by a certain combination of symptoms, is a symptom of inflammation.

101. In medical writings symptoms are often distinguished by such words as *diagnostic* and *pathognomonic* (meaning distinctive), *objective* (or objects of sense), and *subjective,* or sensations experienced by the patient himself.

102. The word *sign* has not the same meaning as the word symptom,

though the two are sometimes used without much discrimination. The difference is best shown by an example. Cough, expectoration, dyspnœa, hectic fever, night-sweats, and emaciation are *symptoms* of pulmonary consumption, but they are not *signs*, for they may all occur in other diseases; but cavernous respiration and pectoriloquy are signs. So also expectoration is not a *sign* of consumption but a symptom, for it occurs in other diseases of the lungs; but a certain kind of sputa is a *sign* of that disease. *Signs*, therefore, are pathognomonic or diagnostic symptoms: that is to say, they point directly to the nature of the existing disease.

103. The term *physical* sign means a sign which is an object of sense. Thus heat, redness, and swelling are physical signs of inflammation; pectoriloquy of phthisis; casts of the uriniferous tubes of disease of the kidney.

104. Between a symptom and a sign there is the same difference as between a *character* and a *characteristic*, and symptoms become signs when their import is thoroughly understood.

105. The symptoms of disease are of very variable intensity; and even the most characteristic are sometimes wanting, or replaced by their opposites. Thus a frequent pulse is a most constant symptom of pulmonary consumption; but in some cases it does not exceed its average in health; while in others it falls below it; and of two attacks of consumption occurring in the same person, and not otherwise different, one has been known to be marked by a frequent, the other by an infrequent pulse. This same symptom of increased frequency of pulse is among the most constant and characteristic attendants on fever, and yet some epidemics have been distinguished by a pulse below the healthy standard.

106. (*c*) *Diagnosis*, or the discrimination of diseases, is the necessary prelude to their treatment. It presupposes a correct observation and just appreciation of symptoms, and may be said to be the art of converting *symptoms* into *signs*.

107. The general appearance of the patient is always an important element in the diagnosis. In most cases it enables the physician to form some idea of the previous habits of life; to determine whether the illness is slight or severe; and, in many instances, to decide at once upon its nature. Thus, anæmia, consumption, pneumonia, emphysema, Bright's disease, fever, and severe disease of the heart are often written on the very countenance; and many other diseases, such as palsy and chorea, gout and rheumatic fever, tetanus and hydrophobia, several of the exanthemata, and skin diseases in general, betray themselves by single strongly marked symptoms. The diagnosis in such cases is very easy; but the task of the physician is much more difficult when the disease is either imperfectly developed, as in the first stage of eruptive fevers, and in incipient phthisis, or when the only obvious symptom is one which, like dropsy, may depend on several causes; and it is still more difficult when the nature of the complaint must be inferred chiefly from the patient's description of his own sensations, or from a mere perception of the size and shape of a part

of which the structure is concealed from view, as happens with the greater number of tumors, both external and internal. These are the cases which put the knowledge and skill of the physician to the test, and sometimes baffle both.

103. In some cases we have to wait until the characteristic symptoms show themselves; in others, to make minute stethoscopic examinations; in others, to test the urine, or to use the microscope; and in a few, to confess our ignorance. The effects of remedies, such as bloodletting and stimulants, also, in rare instances, serve as means of diagnosis. The symptoms which render us most assistance in distinguishing one disease from another will be carefully examined in a future chapter.

109. (*d*) *Prognosis.*—This word means foreknowledge, and, as used by the physician, the anticipation of the course and event of diseases. The power of foretelling the progress and termination of a malady is of the first importance, as regards the treatment to be adopted, the well-being of the patient, his own satisfaction and that of his friends, and the reputation of the physician himself. A correct prognosis implies a just diagnosis, an accurate knowledge of the natural course and progress of disease, an appreciation of all the peculiarities, original and acquired, which distinguish one man from another (§§ 4–86), and a large experience of the virtues and power of remedies.

110. Among the questions which the physician may be called upon to solve, one of the most common is, whether the disease admits of cure? The answer is sometimes very easy. A case of hydrophobia or of hysteria would present no difficulty. The one is as certainly fatal as the other is curable. But in a case of tetanus, of pneumonia, or of pulmonary consumption, the prognosis is more difficult. The first would be most probably fatal; the second is always attended with danger, the amount of which will chiefly depend on the sex, age, temperament, and previous habits of the patient; the third is fatal in a large majority of cases, and the probability of ultimate and complete recovery is very slight.

111. This latter disease—pulmonary consumption—affords a good example of the necessity of caution in forming and stating our prognosis. The disease is incurable, and medicine, at best, only palliative; but if, in every case, a physician were to foretell a fatal result, his reputation would suffer severely, for the simple reason that consumption, though ultimately fatal in nine hundred and ninety-nine cases out of a thousand, is not necessarily fatal in any given attack, recoveries from several successive attacks being by no means unusual; and this happens, not because the disease is curable, but because its fatality depends on the amount of tubercular deposit, and the issue of any particular attack on the extent and activity of the suppurating process relatively to the power of the patient to bear the wear and tear consequent upon it. This is the true explanation of the asserted efficacy of medicines, regulated temperature, and change of climate in this disease, and of the reputed success of those irregular practitioners who select it as the object of their attention partly for the reasons

assigned, and partly on account of the great number of people subject to its attacks.

112. This is the place to speak of that *vis medicatrix naturæ*—that power inherent in the human frame to right itself when suffering under severe disorders—which our predecessors were wont to acknowledge with such befitting modesty as their invaluable coadjutor in the treatment of disease. The homœopathist (slave of an hypothesis invented by a heated enthusiast, and mainly supported by imaginary sensations developed by experiments on his own person) attributes to infinitesimal doses virtues simply ridiculous, and results utterly impossible ; but the regular practitioner can explain the cures alleged to have been thus effected by that very *vis medicatrix* which so constantly stands him in stead in his own treatment of disease, and to which he so rightly attributes so much of his own success. It is this *vis medicatrix* which, counteracted by active medicines, but restored to freedom by non-interference, constitutes the really efficient agent of a race of quacks whose treatment, if honestly carried out in accordance with their own principles, would be perfectly harmless, provided it did not shut out prompt and active treatment in those cases which demand it.

113. The history of every department of the healing art affords examples of the power of this *vis medicatrix*, which often reveals itself through some happy accident ; as when Ambrose Paré, through his supply of boiling oil falling short, was led to substitute a cold slimy mixture, which, like the famous remedy of a contemporary, known as the "oil of whelps," had the happy effect of leaving Nature to work her own cure in her own way.

114. It follows, then, that to determine whether a patient's recovery has happened through the treatment adopted, or independent of it, or in spite of it, is often a task of extreme difficulty. The best physician may often decide amiss ; the ignorant empiric and equally ignorant public are utterly unqualified to form an opinion.

115. (*e*) *Treatment.*—A correct diagnosis, a knowledge of the nature of the disease itself, of the constitution of the sufferer, and of the virtues of remedies, are essential preliminaries to judicious treatment. The object to be aimed at will vary with each case. In one, it will suffice to remove the ascertained cause ; in another, it will be necessary to restore the healthy function or repair the diseased structure ; in a third, to palliate the suffering which the disease occasions.

116. Our treatment is usually founded on a correct knowledge of the nature of the disease and the mode of operation of our remedies, in which case it is said to be *rational ;* in some instances, we act in ignorance of both, and then it is said to be *empirical.* Again, it may be *curative*, or such as to restore the patient to health ; *palliative*, or adapted to the alleviation of suffering ; *preventive*, or calculated to obviate the recurrence of disease, by maintaining habitually a better state of health, and removing its exciting causes.

117. The abstraction of blood in inflammation is an example of *rational* treatment, for we know both the condition of the part affected and the *modus operandi* of the remedy. The use of quinine or arsenic in ague is merely *empirical*, for we understand neither the nature of ague nor the mode in which these medicines affect the body in curing it. The treatment of malignant diseases is necessarily *palliative*, for, from their very nature it is obvious that they do not admit of cure.

118. In the treatment of many diseases we combine the rational with the empirical, the curative with the palliative. Thus, during an attack of remittent fever, we might abstract blood to subdue local inflammation, use cold sponging to diminish the heat of the surface, stimulants to counteract debility, and quinine to effect a cure.

119. Though the use of remedies, the *modus operandi* of which we do not understand, is *empirical*, the act of generalization by which we infer the utility of the same remedies in analogous disorders, imparts to our treatment a more rational character. The employment of quinine and arsenic in ague, for instance, was, and continues to be, empirical, but the use of those remedies, in the whole class of intermittent disorders, as a consequence of analogical reasoning, is a rational procedure.

120. In treating disease we are necessarily guided by the existing state of the patient. If, for instance, the skin, gums, and tongue are pale, we prescribe some preparation of iron ; if, on the contrary, they are florid, we shall probably order depleting or lowering remedies. Now these opposite states are said to afford *indications* of treatment—grounds or reasons, that is to say, for giving preparations of iron in the one case, and resorting to lowering measures in the other. On the other hand, these same states of system constitute grounds for avoiding the opposite modes of treatment: in other words, they are *contra-indications* of depletion and tonic treatment respectively. In like manner acute inflammatory symptoms, occurring in robust persons, *indicate* lowering remedies, and *contra-indicate* stimulants.

121. The considerations brought forward in this chapter will serve to show the extreme difficulty which attends the practice of medicine, and the necessity imposed on the physician of supplying himself with very extensive and precise information on all the subjects which can conduce to a knowledge of the body, and of the action of remedies upon its various functions. But, after all that can be done, the science of medicine must remain extremely imperfect, and the art of healing very difficult. Our general principles, derived originally from particulars made up of many variable elements, must be reapplied in practice to individual instances as complicated as those out of which they were originally formed, so that precision is, in the nature of things, impossible, and certainly of very rare attainment.

122. Other considerations, which go far to explain the acknowledged difficulty of medicine, both as a subject of scientific inquiry and of practical application, are: the variable severity of diseases bearing the same

name, the changes that occur in the progress both of acute and chronic cases, and the unequal strength of our remedies. When we reflect that, prior to the setting in of a given disease, the constitution of the patient, originally marked by hereditary peculiarities, has been subsequently modified by the powerful influences already examined; that the disease itself may vary within wide limits of intensity; that it passes naturally through many different phases; that it may fall under observation and treatment at any part of its course; that the remedies prescribed, being of variable strength, may be given with more or less care and regularity, and the patient tended with greater or less watchfulness and skill: when we take all these circumstances into consideration, we cannot be surprised that medicine should be as a science most uncertain, as an art most difficult.

123. One application of these remarks is obvious. Medical men, and still more the uninformed public, are apt to form unsound opinions on cases in which one physician following another has seemed to be successful, where his predecessor had failed. Is it not obvious that in many such cases the apparent failure and success were due not to difference of skill, but to the stages of the malady at which the two were consulted?

124. In epidemics, again, the physician who may happen to be called to the earlier cases would seem to be unskilful when compared with one who is called upon to treat cases of the epidemic in its more advanced stage; for epidemics are uniformly more severe at their onset than at their decline.

CHAPTER II.

CAUSES OF DEATH.

125. Though the causes of death interest chiefly those engaged in preventing disease, the practical physician profits by the study of them, inasmuch as he learns the relative frequency of the more severe diseases, and the demands they severally make on his attention.

126. The causes of death form three leading groups: of which the first comprises mechanical injuries, scalds, burns, and corrosions, the several forms of suffocation, cold, want, intemperance, and poison; the second, debility in infancy, and decay in age; and the third, disease properly so called. In England the deaths are distributed through these three classes in the following proportions per thousand deaths:

Class I., 40 deaths; Class II., 160 deaths; Class III., 800 deaths.

127. In Class I. about half the deaths are caused by mechanical injuries; about a fourth by the several forms of suffocation (hanging, drowning, etc.); less than a fifth by burns and scalds; ten per thousand by cold and want; thirty per thousand by poison; and thirty per thousand by intemperance (exclusive of delirium tremens and other fatal diseases occasioned by excess).

128. In Class II. the deaths are divided between those that occur in early infancy from incomplete development and inadequate nutrition, and deaths from old age; the excess being somewhat on the side of the first division.

129. The 800 deaths in the 1,000 that remain after subtracting Classes I. and II., may be distributed into a few leading groups of disease. A very large and important group consists of epidemic diseases propagated by contagion or infection, which destroy life by giving rise to severe local affections or by exhausting the vital powers. This comprises small-pox, scarlet fever, measles, whooping-cough, typhus and puerperal fevers, and erysipelas. A second class of maladies is due, like the foregoing, to external causes, which are local or endemic, and rarely, if ever, spread by contagion. To this belong ague, remittent and enteric fevers, influenza, diarrhœa, dysentery and cholera, diphtheria, quinsy, and carbuncle. A third class consists of diseases that prove fatal chiefly to infants and young children. They have their source in the local irritation of teething, worms, or constipation, and lead to fatal affections of the brain and of the intestinal canal. This comprises infantile fever, marasmus, and hydro-

cephalus. A fourth—the largest class of all—is made up of diseases which consist in a structural change or degeneracy of some texture or organ. To this belong scrofula, pulmonary consumption, and cancer. Diseases occasioned by some special impurity, or change of consistence in the blood, constitute another class, of which rheumatic fever, scurvy and gout, with pyæmia, are members. The remainder of the list is made up of fatal diseases of special organs, and of the accidents attendant on childbirth. Of special organs, those of respiration (even after exclusion of pulmonary consumption) occasion the highest mortality; then, in order, those of the brain and nervous system; organs of digestion; heart and circulation.

130. The 800 deaths from disease remaining after subtracting from the whole 1,000 deaths those due to all other causes, are made up in the following manner:

Diseases due to structural degeneration (including pulmonary consumption),	160
Diseases of the organs of respiration (exclusive of pulmonary consumption),	150
Contagious and infectious diseases,	140
Diseases of infancy and childhood,	90
Diseases of the brain and nervous system,	70
Epidemic diseases not being contagious,	60
Diseases of the organs of digestion and assimilation,	60
Diseases of the organs of circulation,	40
Diseases due to changes in the blood,	10
Diseases of the urinary organs,	10
Childbirth, etc.,	10

131. If we distribute fatal diseases, as far as possible, in accordance with the parts which they attack, we obtain, for 1,000 deaths, the following results:

Organs of respiration,	310	
Brain and nervous system,	144	
Organs of digestion and assimilation,	104	
Heart and organs of circulation,	35	
Urinary organs,	10	
Childbirth and organs of generation in a female,	10	
Joints and organs of locomotion,	9	
Skin and integumentary system,	6	–628
All other causes,		372
Total,		1,000

132. If from diseases of organs and systems of organs we pass to single diseases, we obtain, for 1,000 deaths, the following figures:

Pulmonary consumption,	125
Bronchitis and asthma,	78

Pneumonia,	62
Convulsions,	59
Scarlatina,	41
Typhus and enteric fever,	38
Diarrhœa, dysentery, and cholera,	36
Whooping-cough,	24
Paralysis and apoplexy, each,	21
Hydrocephalus and measles, each,	18
Cancer,	14
Tabes mesenterica,	11
Croup and teething, each,	10
Influenza, inflammation of brain, and bowels, each,	8
Scrofula,	7
Small-pox,	6
Erysipelas, epilepsy, and rheumatism, each,	5
Ileus, intussusception, and intestinal stricture,	4
Inflammation of the liver, peritoneum, and larynx, jaundice, pleurisy, and thrush, each,	3
Syphilis, ulcer of intestines, hernia, ascites, inflammation of stomach, and Bright's disease, each,	2
Pericarditis, remittent fever, delirium tremens, insanity, diabetes, and infantile fever, each,	1
Quinsy, purpura, aneurism, cyanosis, gout, intemperance, inflammation of the bladder, carbuncle, inflammation of the kidney, stone, stricture of the urethra, ovarian dropsy, noma, tetanus, ague, ischuria, fistula, and chorea, each less than	1

The mortality from some of the last-named diseases is very small: 164 in the million from cholera; and 33 from hydrophobia.

133. A Chapter on the Causes of Death would be incomplete if some notice were not taken of what are sometimes called the *proximate causes* of death, or "modes of dying."

Death may be said to happen when the heart ceases to beat. Hence, in considering the proximate causes of death, we are inquiring by what means the action of the heart may cease. The first and most direct mode affects the heart itself, which may be either paralyzed by a nervous shock, or weakened by chronic disease. The second, by withdrawing, suddenly, or slowly, the blood which should act as the stimulus to its action. The third, by cutting off, more or less suddenly, the arterial blood from the left side of the heart by an impediment to the breathing. These three causes of death, or modes of dying, may be fitly termed *asthenia*, *syncope*, and *apnœa*.

134. (1.) Death by *asthenia*. The heart of a perfectly healthy person may be suddenly stopped by causes acting with great force on the nervous system: by the lightning-stroke, by strong mental emotion, by a stunning blow on the head, by a blow on the pit of the stomach, or by

the shock of cold drinks. One or two active poisons, such as prussic and oxalic acid in full doses, certain poisons introduced directly into the circulation, air penetrating through an open vein to the right side of the heart, and the sudden effusion of blood on the surface, or into the substance of the brain, may also cause this sudden arrest of the heart's action. The chronic structural diseases that bring about this sudden or speedy death are fatty degeneration, which impairs the muscular tissue itself, or ossification of the arteries, which checks the supply of arterial blood to the walls of the heart. Either of these conditions may so weaken the heart, that the causes just enumerated, acting with comparatively slight force, may occasion a sudden and fatal pause in its action.

135. (2.) *Death by Syncope.*—This may be brought about either by a sudden pouring out of a large quantity of blood from a wounded or ruptured vessel, or by the slow drain of chronic hemorrhage or exhausting discharges; the quantity of blood being so reduced, and its quality so impaired, that it ceases to act as an efficient stimulus to the heart. Ruptures and wounds of the heart destroy life partly by syncope and partly by impairing the propulsive power of the organ.

136. (3.) *Death by Apnœa.*—This is by far the most common form of death. The majority of persons die suffocated; a few by direct suffocation; a much larger number by that slow failure of respiration which attends the exhaustion of the strength by all severe diseases. Direct suffocation may be occasioned by constriction of the throat, as in hanging, strangulation, and throttling; by closing the mouth and nostrils; by pressure on the chest; by exclusion of air, as in drowning; by the substitution of a gas not containing oxygen for atmospheric air; by spasm of the glottis; by inflammation and swelling of the upper part of the larynx; caused either by hot water or corrosive poisons, or by disease; and by small foreign bodies wedged between the walls of the rima glottidis. Direct suffocation is of comparatively rare occurrence in disease. It may arise from causes affecting the larnyx, or trachea, as laryngitis and croup, or from collections of blood, pus, or mucus filling up the small branches of the air-tubes and the air-cells. It may also arise from the admission of air into the pleura of one lung, the other being diseased, or from large effusion of blood or of serum rapidly poured out into the pleural sac. But, as has been just stated, the majority of deaths from apnœa are due to that gradual failure of the respiration which attends the exhaustion brought about by all severe diseases, and of which the quick laborious breathing and loud mucous râle (death rattle) are the well-known indications. It is in this way that apoplectic seizures, not sudden or violent enough to occasion death by *asthenia*, or shock, as well as most structural diseases of the brain, terminate.

CHAPTER III.

PHYSIOLOGY AND GENERAL PATHOLOGY.

137. The human body is a machine of finished workmanship and vast variety of uses, infinitely surpassing the most perfect work of man's hands; and containing within itself the means of ministering to its own growth and preservation, of repairing many injuries to which it is exposed, and of generating other machines of like structure and endowments. It is also a laboratory, in every part of which, at every moment, the most delicate chemical processes are being performed. This machine, with its exquisite mechanism and refined chemistry, is subject to change of place, to deprivation of the means of living, to violent death, or to slow decay, according to the dictates of a voluntary agent so dependent upon it, that all signs of his existence vanish before the last traces of its own vitality have disappeared.

138. All the minute structures of this machine were believed to be built up, all its movements to be regulated, and all its chemical processes carried on under the direction of a force, acting through a machinery of its own, and manifesting its presence only by its effects. This force was called the *vital principle*. It was thought to be an independent entity, a ψυχή, or soul, pervading the tissues and causing them to live; while its disunion, or separation, from the body was death.

But, according to a more modern theory, life is the collection of phenomena in organized beings, dependent partly on a certain structure and chemical composition, and partly on external agencies which stimulate them to action; death ensuing when the structure is seriously damaged, or the external stimuli are withdrawn.

139. On closer examination, the body is found to consist of the following parts:—A framework for locomotion and for the protection of its more important organs; a digestive apparatus for the assimilation of its food; organs of circulation for distributing the nutrient fluid blended with the pre-existing blood; glands for the secretion of fluids needed in the economy; other glands for the purification of the blood, which is constantly being contaminated in the process of nutrition; a nervous network bringing all the important internal organs of the economy into harmonious action; and a nervous mass of brain and spinal cord, the centre of sensation, volition, and thought.

140. All these parts are most closely and intimately associated; so that

if the heart cease to circulate blood, or the lungs to purify it, the nervous system will no longer send forth those stimuli by which the heart beats and the chest breathes. If, on the other hand, the nervous centres suffer severe injury, respiration is prevented or impeded, and the heart soon stops. External influences also affect not the part only on which they act, but through it other organs, and through these the entire frame. Again, the mind acts on the body, and the body reacts on the mind, and both together form a being so intricate, yet so perfect in structure, so complex, yet so plastic in function, that the preservation of its health, and the continuance of its life, appear as wonderful as its slow decay and certain death. But experience proves that the body is so constituted that while under favorable circumstances it enjoys the free play of all its parts, under unfavorable ones it is subject to serious derangements of function and alterations of structure.

This brief outline will serve to indicate the following as the contents of the present chapter:

1. The physiology and general pathology of the fluids, including digestion, chylification, sanguification, and excretion.
2. The physiology and general pathology of the circulating organs, considered as instruments for the distribution of the blood.
3. Structural physiology and pathology.
4. The physiology and general pathology of the nervous system.
5. Mental physiology and pathology.

1. PHYSIOLOGY AND GENERAL PATHOLOGY OF THE FLUIDS.

141. Digestion, absorption, and assimilation of the food; the composition and properties of the blood and its constituents; and the functions and secretions of the lungs, skin, kidneys, and liver, are the subjects to be considered under this head.

142. *Digestion.*—The exhaustion and change of the materials of which the body is composed is a condition of vital action; so that every sensation, thought, movement, and act of secretion is attended by the conversion of a corresponding portion of the tissues into materials that are no longer fitted for the purpose of growth or nutrition, but actually impede both. They are, therefore, absorbed into the blood, and converted into definite compounds, which are separated and cast out of the system, by glands appointed to this service. To supply the place of this waste is one of the uses of our food.

143. In an adult in perfect health and vigor, and using no undue exertion of mind or body, the daily waste is repaired by the daily food, and the weight of the body undergoes little or no change from day to day. But this nice balance of waste and supply may be destroyed by increased exertion without proportionate increase of food, by diminished supply, or by excessive muscular exertion, as in training for the turf; or, lastly, with great rapidity, by entire abstinence. In all these cases the body loses

weight. On the other hand, in healthy persons, with unimpaired digestion, it gains weight by inactivity, or, within certain limits, by increase of food.

144. In certain diseases waste goes on with extreme rapidity; as in fever, when rapid destruction of the textures is combined with complete loss of appetite; in pulmonary consumption, when the local waste, added to profuse sweats or discharges from the bowels, exceeds the powers of assimilation; in tabes mesenterica, in which the diseased glands refuse to elaborate the chyle; in diabetes, when mal-assimilation of the food checks the process of repair of even a moderate loss of substance; during exhausting discharges, which drain the body of its blood; and in some local diseases or injuries, attended by a loss of substance which the most nourishing diet cannot repair.

145. During the early period of life food is required not merely to supply the material exhausted in the use of parts, but to furnish new material for growth. Hence the large consumption of food in childhood and youth in proportion to the dimensions of the frame.

146. One use of food, therefore, is to supply the waste constantly going on; and in order that it may discharge this function, it must contain all the elements and compounds, organic and inorganic, of which the body is composed. If the food be destitute of some essential element the health sooner or later suffers. The omission betrays itself in severe functional derangements, arrests of development, or well-marked structural lesions. Water is no less essential than the food, into the composition of which, as of the body itself, it enters so largely. It cannot be withheld, even for a few days, without serious consequences, and the want of it entails sensations far more distressing than those of hunger.

147. The sensations of *hunger* and *thirst* warn us of this twofold waste of the solids and fluids, and invite us to repair it.

148. In healthy temperate persons these sensations bear a just relation to the wants of the body; but there are some diseases in which they are disproportionate to them; and there are modes of life which blunt these sensations, or render them unduly acute.

149. A sensation of hunger disproportioned to the wants of the body is not uncommon. It is present in certain nervous disorders, in many cases of unsound mind, in some persons who lead an indolent and inactive life, and in rare cases it reaches a point of intensity known as *Bulimia*. The appetite, again, may be unduly stimulated by condiments, and by the arts of a refined cookery. On the other hand, it may be blunted by the abuse of opium, tobacco, and spirituous liquors; disregarded during intense mental application, or prolonged grief, and destroyed by sudden emotion. It is also impaired or suspended in most diseases, but especially in their acute form.

150. The sensation of hunger, though usually a fair measure of the wants of the body, sometimes deceives us as to its power of making a profitable use of food. In tabes mesenterica, for instance, the body wastes from disease of the mesenteric glands; but as the stomach remains sound, the

appetite bears a due relation to the wants of the frame, and is often voracious. In the advanced stage of the disease, however, when hectic fever sets in, the appetite and digestive power alike fail.

151. The same observations hold good in respect to thirst; which may become disproportioned to the wants of the body from the use of too stimulating a diet, salt meats, or spirituous liquors in excess. Intense thirst is also highly characteristic of the action of irritant poisons, partly due to inflammatory heat of the throat and fauces, and partly to the pressing necessity for the dilution of the poisoned blood. The analogue of bulimia is morbid thirst, known as *Polydipsia.*

152. As, in a healthy state of body, the appetite is an index of the amount of food required to repair waste, so, in certain diseased conditions, does its utter failure point out the expediency of total abstinence. This is especially the case during severe febrile attacks, when all the secretions being suppressed, and gastric juice no longer formed, digestion becomes impossible, and indifference to food is heightened into positive loathing, or *nausea.*

153. But though hunger and thirst, in a healthy person, and under ordinary circumstances, are accurate indications of the wants of the frame, they are not so exact as to supersede the influence of habit; for experience proves that a considerable latitude in the quantity of food and in the number of meals is quite compatible with sound health. Nature does not precisely direct either the quantity or the time.

154. Nor is the kind of food best adapted to our wants indicated with such precision as to preclude the use of dietaries varying greatly in different climates and among different races; for though the form of the teeth is held to prove that man may partake both of animal and vegetable food, experience proves that a diet consisting chiefly or exclusively of the one or the other is consistent both with health and strength.

155. In infancy, however, the diet best suited to the wants of the body is unmistakably indicated both by the absence of teeth and by the supply of the food itself. At this period a diet differing materially from that supplied by nature is often attended by fatal results. This is one of the causes of the great mortality of infants, and especially of foundlings, of those put out to nurse, and of those whose mothers are much separated from them by their employments.

156. The first step in digestion consists in the cutting and bruising of the solid portions of food by the teeth, the moistening of them by the saliva, and their propulsion into the stomach. The conditions of the perfect performance of this first act of digestion are, therefore, sound teeth, careful mastication, and sufficient saliva. Decayed teeth and mastication imperfectly performed, either from habit or occupation of mind, are, therefore, very efficient causes of indigestion.

157. But the saliva serves another purpose. It has the power of promptly converting starch into sugar, and thus a portion of the starchy constituents of our food are digested in the mouth.

158. The food thus bruised, moistened, and changed in composition, when received into the stomach, undergoes a continuous churning movement, by means of the muscular contraction of the wall of the organ. This peristaltic action is such as to cause the food to rotate obliquely from above downward, in two directions simultaneously ; from the orifice of entrance by the orifice of discharge back to the entrance again. In this way the whole of the food becomes thoroughly mixed with the gastric juice. The part of the stomach near the orifice of discharge is meanwhile constricted, so as to form a sort of supplemental cavity, into which the fully digested food is received, and out of which it is allowed to pass into the duodenum by occasional relaxations of the sphincter which closes the aperture of discharge.

159. The gastric juice, under the stimulus of the food, is clear, transparent, without odor, slightly salt, and perceptibly acid, the acidity being due to hydrochloric acid. Its essential constituent is a peculiar principle called *pepsin*, which promptly disintegrates the fibres of flesh ; converts coagulated into soluble albumen, and checks putrefaction. It is poured out rapidly, in quantity proportioned to the food ; but if the food exceed the wants of the frame and the indications of the healthy appetite, part remains undigested, and undergoing decomposition generates carbonic acid and other gases.

160. When the food is solid or pulpy, the gastric juices act on it almost immediately ; but when liquids in excess are taken with it, they must be first removed by absorption ; and this delay also favors dyspepsia.

161. The time required for digestion in the stomach varies in different persons, and in the same person under different circumstances ; also with the quantity, quality, and consistence of the food itself, and the quantity of saliva and of other liquids mixed with it. After a full meal an interval of four or five hours should elapse before taking fresh food.

162. The states of body and mind favorable to digestion are repose and cheerfulness. Strong exercise, and anxiety or preoccupation of mind, impair the power of the stomach. Short and long intervals between meals are also injurious ; the one by overtasking the stomach, the other by depressing the nervous power.

163. The gastric juice, kept at the temperature of the body and in motion, acts out of the body almost as well as in the stomach. If the temperature is much lowered, its power is greatly impaired, and when raised to 115° or 120° Fahr. is destroyed and cannot be restored. An artificial digestive fluid may be made by soaking the fresh mucous membrane of the stomach of an animal in dilute hydrochloric acid (0.02 per cent.) ; and if kept at from 99° to 100° Fahr. it slowly dissolves coagulated albumen and meat.

164. Important facts relating to digestion, and the properties of different kinds of food, have been obtained by Beaumont, Londe, and others, who had opportunities of closely observing persons having fistulous open-

ings in the stomach or small intestines. Their chief conclusions may be briefly stated as follows: 1. Animal food is more completely digested than vegetable food, is retained longer, appeases hunger more completely, and is more stimulating. 2. Vegetable substances leave the stomach with their texture only partially destroyed. 3. When animal and vegetable food are taken together the vegetable portion leaves the stomach first. 4. Fatty substances and oil are not digested in the stomach. 5. Boiled meats are more easy of digestion than roast, and roast than broiled. From Dr. Beaumont's observations on St. Martin, it appears that tripe was digested in an hour; eggs, salmon, trout, and venison in an hour and a half; milk, liver, and fish other than salmon and trout in two hours; turkey and lamb in two hours and a half; beef, mutton, fowls, veal, and pork required from three to four hours, beef being more digestible than mutton and fowl, and veal and pork requiring the longest time. Of ordinary vegetables, rice was digested in an hour, tapioca and barley in two hours; potatoes in two and a half hours.

165. The leading constituents of our food are differently acted on by the gastric juice. Woody fibre, the husks and skins of fruit and grain, horn, hair, and elastic tissue are not digestible; albumen, fibrin, and coagulated casein, and all other varieties of protein, are dissolved and converted into "peptone,"—*i.e.*, a solution of albumen, which is no longer precipitated by neutralization, or by heat, and which, unlike an ordinary solution of albumen, is readily diffusible through an animal membrane; starch, fat, and oil pass from the stomach unchanged, being reserved for the action of the bile and pancreatic fluid.

166. Food of all kinds may be divided into four principal classes—the *saccharine*, *albuminous*, *oleaginous*, and *mineral*. Milk, the nourishment provided for the young, contains all these principles, and they exist in blood.

167. This division was suggested by Prout; but Liebig distributed all the organic constituents or elements into the *nitrogenous* and *non-nitrogenous;* the last consisting of all those substances that can be resolved into oxygen, hydrogen, and carbon, the first embracing all those which contain nitrogen in addition. The non-nitrogenous group comprises fats and oils, gum, starch, and sugar, and spirituous liquors. The nitrogenous group includes the seeds of plants and the blood and tissues of animals, and the albumen, fibrin, casein, gelatin, and other analogous principles that may be separated from them. The non-nitrogenous group Liebig supposed to be heat-making or respiratory; the nitrogenous, tissue-forming or plastic. But it must be remembered that muscle, nerve, and gland-structure contain a considerable quantity of fat. This form of hydrocarbon may therefore be considered so far as tissue-forming. On the other hand, combustible material is formed to some extent from nitrogenized bodies in the changes which they undergo in the body.

168. Albumen, fibrin, and casein are constituents both of animal and vegetable matters; and they resemble each other so closely in chemical

composition that if either of them be dissolved in a weak solution of caustic potash, by the aid of a gentle heat, we obtain from it, by adding acetic acid, the same grayish gelatinous matter, which on ultimate analysis yields about 55 parts of carbon, 23 of oxygen, 15 of nitrogen, and 7 of hydrogen, in every 100.

This is the *protein* of Mulder; of which a hundred parts, with one of phosphorus and two of sulphur, constitute albumen, as found in the serum of the blood; with one of phosphorus and one of sulphur, fibrin; and with one of sulphur, casein.

169. The food, then, before it leaves the stomach, undergoes a twofold process of *reduction* and *conversion.* It is submitted to a chemical action, by which albuminous substances are rendered soluble; and it passes, as a homogeneous pulp, under the name of *chyme*, into the duodenum, where it is largely diluted, and submitted to further chemical changes by fluids poured into it from the liver and pancreas.

170. The *bile* may be briefly described as a thin soapy fluid, which by its alkalinity aids the pancreatic fluid in neutralizing the acid chyme and precipitating any imperfectly digested albumen (parapeptone), and in emulsifying the fatty constituents of food. It also facilitates the absorption of fatty matter; prevents by its antiseptic properties the decomposition of food during its transit through the alimentary canal; and at the same time facilitates its passage by a stimulant action on the muscular walls of the intestines. But when the bile is mixed with gastric juice out of the body, or when it regurgitates into the stomach, it arrests the process of digestion.

171. The *pancreatic fluid*, aided to some degree by the bile, forms the fatty matters and oil into an emulsion, in which state they are absorbed by the villi clothing the surface of the jejunum and ileum; converts any starchy matters which escaped digestion in the mouth into sugar; neutralizes (with the aid of the bile) the acid chyme, and if any portion of the albuminous constituents have escaped complete digestion, precipitates them (as parapetones), and ultimately decomposes them into leucin and tyrosin, intermediary (and often excretory) products between albumen and urea.

172. As one function of the pancreatic fluid is to dissolve fatty matters, the discovery of these in the stools affords a strong probability of disease of the pancreas.

173. The action of the pancreatic fluid ends here; but the bile appears to play an important part in the economy by subserving the function of respiration; its principal constituents, *taurin*, *cholic acid*, and *glycocin*, being rich in carbon.

174. These highly carbonized constituents of the bile in their passage through the intestines are absorbed into the blood; a small portion (estimated at a thirty-fourth part of the entire secretion) being rejected from the body in the fæces.

175. The fœtal liver doubtless performs analogous functions. The

bile is secreted, and poured into the intestines, as in the adult; that portion which is fitted to form part of the circulating fluid is absorbed; while that which in extra-uterine life mixes with the undigested remnant of the food and other effete matters, and is periodically discharged from the bowels as *fæces*, collects in the intestines as *meconium*, and is expelled soon after the birth or during delivery.

176. The portal vein formed by the convergence of all the veins which ramify on the alimentary canal, as well as those from the spleen and pancreas, contains all the products of digestion which have been absorbed by the blood-vessels, and carries them into the liver. It is from this mixed blood that the bile is separated, and as the quantity of bile depends on the supply of blood from the intestines, the intestinal vessels are filled, and the functions of the intestinal canal promoted, by free action of the liver. Venous congestion of the liver, therefore, implies congestion of the mucous membrane of the stomach and intestines, and dyspepsia, as a result; also hemorrhoidal discharges, which afford direct relief both to the liver and the alimentary canal.

177. Biliary congestion may originate in defective action of the lungs, or in overfeeding. The liver, as we have seen, separates hydrocarbons from the blood, and in a healthy state these are consumed in the process of respiration; but if this function be impaired, the bile accumulates, distends its vessels, and either transudes them and gets into the blood, producing jaundice; or it regurgitates into the stomach, causing bilious vomiting, or is poured out into the intestines in undue quantity, setting up bilious purging. In cold climates, a sedentary life, giving little play to the lungs, conjoined with indulgence in the pleasures of the table, leads to an increased secretion of bile, part of which passing into the intestines, doubtless tends to prevent pulmonary congestion, and part, being absorbed into the blood, tinges the conjunctiva and skin. Strong exercise in the open air, by calling the lungs into activity, lessens the necessity for the formation of bile, rapidly removes symptoms of indigestion, and restores the natural clearness of the complexion. In hot climates, again, the demand upon the lungs for the combustion of the carbon and hydrogen of the blood being diminished, if more food be taken than is required, bile is formed in increased quantity. In either case (whether in cold or hot climates) habitual excess in eating and drinking, and especially the free use of the liquid hydrocarbons (the several forms of spirituous liquor), leads to the same result—functional or organic disease of the liver.

178. Thus the intermediate position of the liver—between the lungs (through the right cavities of the heart) and the intestines (through the vena portæ), accounts for the frequency of functional and organic diseases of the liver, occurring as indirect consequences both of pulmonary and of intestinal disorders.

179. The chemical process of digestion carried on successively by the saliva, the gastric juice, the bile, and the pancreatic fluid, is not completed

in the duodenum, but continues throughout the small intestines, and is probably finally completed in the cæcum by the solution of the last undigested portions of vegetable matter.

180. As the solution of the chyme is effected, it is absorbed in its passage through the alimentary canal by the blood-vessels, and in the small intestines by the lacteals also. The indigestible and superfluous portions mixed with the secretions contained in the upper part of the tube, pass into the large intestines, whence, after the absorption of some of its liquid constituents, it is discharged as *fæces*, amounting in quantity to about 1-18th part of the food taken.

181. The indigestible part of the food mixed with the residuum of the bile, forms the natural stimulus to the movements of the intestinal canal; an excess of bile increasing the peristaltic action, a deficiency of it, whether through diminished secretion or obstructed flow, causing constipation. In like manner, an excess of undigested or ill-digested matters, produces diarrhœa; and the absence of all indigestible matter, one of the evils of an over-refined cookery, causes constipation. The passage of the fæces through the intestines is also greatly promoted by the movements of respiration, and by all exercises in which the abdominal muscles are called into play. Sedentary habits, on the contrary, promote constipation.

182. *The Chyle.*—It is the function of the lacteal vessels to absorb an emulsion composed of a mixture of fat and albumen in the finest state of subdivision. The lacteals convey the emulsion through the mesenteric glands. In its passage it is changed into *chyle*, which passing onward reaches the *Receptaculum Chyli.* It there mixes with the lymph collected from the lower parts of the body, and the mixed fluid is conveyed by the thoracic duct into the left subclavian vein, and so becomes part of the blood.

183. The interruption or imperfect performance of this process of *assimilation*, leads to the formation of several secondary organic compounds, the presence of any one of which impairs the health. Thus mal-assimilation of the starchy constituents leads to the formation of sugar, as in diabetes, of oxalic acid, as in oxalic acid lithiasis, of lactic and acetic acid, as in certain forms of dyspepsia, of lactic acid alone, as in rheumatic fever. Mal-assimilation of the albuminous constituents results in the formation of uric acid, as in gout, and the cystic oxide lithiasis.

184. A tendency to mal-assimilation is given by habitual excess in the use of the several constituents of food. If fatty substances, for example, be taken too freely, bilious derangement is apt to occur, and gout is a familiar example of the effect of the abuse of animal food.

185. The *Chyle* varies in its composition according to the nature of the food. When this consists of a due admixture of fatty and albuminous matters, it is a milky alkaline fluid, having in the thoracic duct a yellowish or reddish tinge. When removed from the body it coagulates spontaneously owing to the formation of fibrin. The quantity of fibrin is varia-

ble, but always less than that of blood. The clot is therefore much looser. The other constituents are fat, about 5 to 10 parts in 1,000; albumen 30 to 50; salts from 4 to 5 parts; and the granular corpuscles—bodies which strongly resemble the white corpuscles of the blood, and have a vesicular nucleus which sometimes attains the dimensions and color of the blood discs themselves.

186. The *Lymph* is a colorless, slightly milky, alkaline fluid resembling chyle in all respects, but that it contains only a trace of fat, less solid matter, and fewer corpuscles.

187. The food has now been traced through the successive physical and chemical processes of digestion and absorption to its mixture with the mass of the circulating fluid. With regard to that portion which is absorbed by the villi, it is pretty conclusively proved that the emulsion of fat and albumen is formed in the mesenteric glands into chyle corpuscles, or leucocytes, indistinguishable from the white corpuscles of the blood (see pp. 41 and 42); and Mr. Wharton Jones, followed by other observers, has concluded that red blood corpuscle is the altered and escaped nucleus of the lymph corpuscle.

The same process of cell formation takes place in the ordinary lymphatic gland, so that we may regard this whole system of glands as having for their proper function the renewal of the essential constituent of the blood—viz.: the red corpuscle.

188. The blood which flows in the veins varies in different parts, inasmuch as the general mass of venous blood is continually being mixed with the lymph and chyle. The blood of the portal vein abounds in water, alcohol, sugar, fat, unassimilated albumen, and other constituents of the food directly absorbed by the capillaries of the alimentary canal. The blood of the splenic vein is remarkable for the small proportion of red, and large proportion of white, corpuscles; and for a large increase in the quantity of albumen and fibrin. It is the function of the liver and lungs to convert this crude fluid into arterial blood.

189. The blood in the body of an adult has been variously estimated at from 8 to more than 30 pounds. The quantity which can be made to flow from the body of a decapitated criminal, added to that which can be washed out of its vessels, is about an eighth of the weight of the body itself. This, the highest ascertained proportion, would give 20 pounds of blood for an adult weighing 160 pounds. The quantity must, however, be subject to variation. It is a maximum within a few hours of a hearty meal, a minimum after long abstinence.

190. The specific gravity of the blood is about 1055. It may reach 1059 in robust men, and fall as low as 1050 in women; in pregnant women as low as 1045. It is also low in very young infants. Its temperature is about 100° Fahr. Its color a bright red in the arteries, and dark red in the veins. It is fluid when circulating in the living textures, but coagulates in from three to seven minutes after removal from the body.

191. The blood consists of red particles or corpuscles, to which it owes its color, of colorless finely granular cells (white corpuscles), and of transparent colorless serum, holding fibrin, albumen, and certain salts in solution, and known as *liquor sanguinis* or *plasma.* The red corpuscles which form half its bulk have the high specific gravity of 1088. The white corpuscles bear to the red the proportion of 1 to 1000.

Fig. 1.

192. The blood in coagulating separates into two parts, the crassamentum, or clot, and serum. The clot is formed by coagulated fibrin enveloping the red and white corpuscles and part of the serum. The size and firmness of the clot depend on the quantity of fibrin.

193. The cause of the coagulation of the blood has attracted much attention, and it has been shown that fibrin does not pre-exist in the blood; but that it is formed when the blood is withdrawn from the living influences by the combination of two modifications of albumen called *globulin* and *fibrinogen.* Whenever solutions of these two substances are mixed, fibrin is deposited. Thus serum of blood pressed out of the clot, contains globulin in solution, and has no power to clot; but if it be mixed with a little exudation-serum from a hydrocele, or any serous cavity, a clot is formed from the combination of the albumen (*fibrinogen*) of the serum with the globulin of the blood-serum.

194. It has also been shown that the walls of the living blood-vessels have the power of preventing coagulation, and that this power is lost when the blood-vessels themselves, or any part of them, are injured by direct violence or disease.

195. When blood-letting was much used, certain appearances in the clot were held to prove the existence of inflammation. The appearance supposed to indicate inflammation, to justify the past abstraction of blood, and to warrant a fresh recourse to the lancet, was a concave and buff-colored clot. When it presented both these characters, it was said to be *buffed* and *cupped.*

196. Healthy blood drawn from a vein, and suffered to remain at rest, undergoes two principal changes—the subsidence of a portion of its red particles, and a coagulation of the mass of the fluid. The red particles begin to subside as soon as the blood is drawn; coagulation rapidly follows, and in about ten minutes converts the blood into a loose jelly. The blood, thus transformed from a homogeneous fluid into a nearly homogeneous solid, undergoes a further change, often not completed within twenty-four hours or even more. This consists in the progressive contraction of the fibrin. If the coagulation takes place within a few minutes of the removal of the blood, the whole of the clot is dark red; but in proportion as the process is delayed, so does the upper part of the clot become colorless, owing to the gradual subsidence of the heavy red corpuscles. The depth of the buffy coat may therefore be taken as the measure of the time required for coagulation.

197. But the color of the clot may be influenced by more causes than one. An unusual tendency of the red corpuscles to coalesce and adhere (as has been shown to be the case in inflammation), will cause them to sink more rapidly, and the upper part of the clot will be more or less completely deprived of color. Again, a great diminution of the red corpuscles favors their speedy deposit, and gives rise to the buffy coat. This is the case in anæmia and chlorosis, and a cupped and buffed clot was observed, by M. Andral and others, in 64 per cent. of these diseases. Again, the contractility of the fibrin being the same in two cases, if the quantity is increased in the first and lessened in the second, the clot will be large in the one, and small in the other.

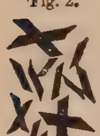
198. The buffy and cupped coat, then, is no sure indication of inflammatory action, but only of an alteration in the relative quantities of the fibrin and red corpuscles, or an excess, either absolute or relative, of the fibrin.

199. The quantity of the *crassamentum*, or clot (the combination of fibrin and red globules with a variable proportion of serum) varies much : the blood of men being more rich in the chief constituents of the clot (fibrin and red corpuscles) than that of women ; and being also in excess in persons of the sanguine temperament.

200. The quantity of *red corpuscles* differs in different persons at different times, and it probably varies with age, sex, temperament, and state of health. According to Becquerel and Rodier, it ranges between 113 and 152 parts (dry) in a thousand ; the average for healthy males being 141, and for healthy females 127.

201. The red corpuscles are biconcave discs, consisting of a delicate, homogeneous, insoluble stroma, containing within its meshes a soluble red coloring matter. The stroma consists of paraglobulin, lecithin, and neurin, with a little cholesterin : the coloring matter is a compound called hæmoglobin. It may be readily separated from the corpuscles and crystallized. The form of the crystal differs in various animals. In man it is an acute rhombic prism (Fig. 2). Hæmoglobin is a remarkable body. It readily condenses and absorbs oxygen and some other gases, and gives them off again under diminished pressure, the crystals meantime changing from bright scarlet to purple. Upon this quality of hæmoglobin depend the respiratory changes which are the source of vital action ; 1,000 parts of moist red corpuscles contain about 300 parts of dry hæmoglobin. Of this nearly 17 parts are hæmatin ($C_{32}H_{34}N_4FeO_5$). This is the noncrystalline coloring matter of the blood, and contains the whole (*i.e.*, according to the above formula, about 9 per cent.) of the iron of the blood. In water the red corpuscles swell by imbibition and become spherical ; but in syrup or any other liquid of denser specific gravity than the blood, they shrink and become puckered from the exudation of their liquid contents. It is probable, therefore, that by swelling when the specific gravity of the blood is reduced, and shrinking when it is increased, the red parti-

Fig. 2.



x100

cles may serve to maintain a more uniform consistence of the circulating fluid. The white corpuscles are spherical and larger than the red. They present contracting and dilating movements of an irregular character, resembling those of the *amœba*. They are often called *leucocytes*.

202. The red corpuscles are variously affected by chemical agents and by some of the secretions. The bile completely dissolves them.

203. The *fibrin* in healthy blood varies from $1\frac{1}{2}$ to $3\frac{1}{2}$ parts in a thousand, the average being $2\frac{1}{5}$. It is more abundant in arterial than in venous blood, in about the proportion of 5 to 4.

204. The *serum* is a straw-colored fluid, holding albumen in solution. When heated to 167° Fahr., the albumen coagulates and separates. It ranges from 62 to 75 parts in a thousand, the average being about 70.

205. The fluid remaining after the separation of the albumen contains extractive matters and inorganic salts (principally of soda) dissolved in water.

206. The several constituents of the serum vary with sex, age, and temperament. The quantity of *water* is greater in females than in males; in children and aged persons than in persons of middle age; and in the lymphatic temperament than in the sanguine. In healthy males it has a range of from 760 to 800 parts in a thousand, and an average of 779; and in healthy females, a range of 773 to 813, with an average of 791.

207. Besides the constituents just mentioned, the blood contains oxygen and carbonic acid gases: 100 volumes of blood contain about 50 volumes of these gases collectively. The proportion of the gases varies considerably; but arterial blood always contains about twice as much oxygen and a third less carbonic acid than venous blood.

Traces of the secondary organic compounds—viz.: urea, uric acid, kreatin, kreatinin, taurin, cholesterin, and leucin, are also found in the blood. When the excretions are checked, these matters accumulate in the blood, and cause serious, if not fatal, derangement.

208. The blood undergoes various changes in disease—(*a*) sensible changes; (*b*) variations in the proportions of its constituents; (*c*) admixture of substances foreign to its healthy composition.

209. (*a*) *Sensible Changes.*—The *quantity* of blood is increased by food, and in plethora. It is diminished by hemorrhage and abstinence. It is also said to be diminished in anæmia; but the pallor which characterizes that disease is due to a deficiency of red corpuscles. Its *temperature* is increased in diseases accompanied by a rapid circulation, such as severe inflammations and inflammatory fevers: on the other hand, it is lowered in languid states of the circulation, and especially when the blood is imperfectly decarbonized, as in apnœa, poisoning by prussic acid, cholera, and cyanosis. The *color* of the blood is more florid in the cases in which its temperature is raised; and darker in those in which its temperature is lowered. It is changed from dark blue to black by contact with acids, whether formed in the body itself or introduced from without; and it has

been described as having a glimmering blue tint in some cases of poisoning by prussic acid.

210. (*b*) *Variations in the relative Proportions of its Constituents.*—The *red corpuscles* are in excess in plethora, and in defect in anæmia. They are slowly reproduced; hence the long continuance of pallor after hemorrhages. The white corpuscles abound in anæmia and in disease of the liver and spleen. The *fibrin* is increased in acute inflammations, especially of the serous membranes, in acute rheumatism, pneumonia, phthisis, erysipelas, tonsillitis, and inflammation of the lymphatic vessels. The greatest increase takes place in acute rheumatism, being sometimes nearly four times as much as in health, and continuing in excess after repeated bleedings. It is also in excess in the pregnant female. On the other hand, its quantity is diminished after severe enteric fever, in cerebral congestions and hemorrhages, in scurvy, in profuse hemorrhages, and in inflammation of the mucous membranes. The quantity of the *serum* increases as that of the *clot* diminishes. The quantity of *water*, in like manner, increases as that of the more solid ingredients decreases. The *albumen* probably bears a near proportion to the fibrin: it is greatly diminished in cases of Bright's disease. The *fatty* matter is increased, according to Becquerel and Rodier, at the onset of most acute diseases, and in chronic nephritis and tuberculosis. Sometimes it is so abundant as to make the serum milky. This has been observed in diabetes and hepatitis. The *salts* of the serum are diminished in enteric fever, and in cholera.

211. The following table exhibits the variation observed in the quantity of the chief constituents of the blood in disease, compared with the average in health.

	Varies between	Average in health.
Albumen,	83 and 52 per 1,000 parts	72
Fibrin,	10.5 " 0.9 " "	3
Fat,	117 " 2 " "	2.5
Corpuscles,	185 " 21 " "	127
Solid matter of serum,	114 " 57 " "	80
Water,	915 " 725 " "	790
Salts of serum,	8 " 5 " "	8

212. (*c*) *Admixture of Substances not found in healthy Blood.*—1. Results of mal-assimilation of the food. 2. Constituents of the natural secretions and excretions. 3. Morbid products. 4. Extraneous matters.

213. 1. The leading results of mal-assimilation of the food are alluded to in §§ 142, 183, and 184. 2. Traces of the proper constituents of the secretions are also normally found in the blood; but when the excreting glands are deranged through functional or organic disease, these substances are apt to accumulate to a dangerous extent. Thus, when the respiration is embarrassed by diseases obstructing the entrance of air, or by exposure to an atmosphere contaminated with carbonic acid, the blood

becomes overcharged with this noxious gas. When the liver is inflamed or its duct obstructed, the constituents of the bile are retained in the blood, or pass into it by transudation. In acute nephritis urea is, in like manner, retained within the system and induces the gravest symptoms. 3. Of the morbid products which find their way into the blood, the chief is pus, which, under certain circumstances, is absorbed from the veins or from suppurating surfaces. 4. The extraneous matters are poisons and parasites, both of which are introduced by the stomach, skin, and lungs, or more directly by penetrating wounds.

214. The constituents of the blood may be separated and thrown out among the textures of the body, or on the surface of membranes, or discharged by the several outlets. Fibrin plays an important part in every process of reparation; serum is formed in the sacs of serous membranes, and in the cellular tissue; and the red corpuscles escape in peculiar states of debility. The white corpuscles also readily pass through the walls of the capillaries when the venous circulation is impeded, and, as they multiply very rapidly, they are regarded as very important agents in the inflammatory process, and in the formation of *pus*.

215. The chyle and lymph which are constantly flowing into the blood bring with them many useful and some hurtful principles which must be discharged from the body. The principal organs by which this is effected are the *lungs*, *skin*, *kidneys*, *liver*, and *intestines*.

216. *Respiration.*—The air-tubes, after repeated divisions and subdivisions terminate in small vesicular cells, on the walls of which a network of minute blood-vessels is distributed. The membrane of these cells, through which the atmosphere acts on the blood, is believed to be at least thirty times as extensive as the surface of the body. The lungs, therefore, constitute one vast excreting surface, from which there constantly escapes into the air a mixed cloud of carbonic acid gas and water. An interchange of carbonic acid and oxygen takes place through the membrane of the cells, by which the one is released and the other absorbed, the absorption of oxygen and the release of water changing the color of the blood from purple to crimson.

217. Viewed as excreting organs, the lungs have this peculiarity, that they require for the due performance of their functions the contact and constant renewal of atmospheric air. This is brought about by the alternate expansion and contraction of the chest, coinciding with the depression and elevation of the diaphragm, movements which in healthy adults are repeated about eighteen times in a minute, but less frequently when the body is at rest.

218. The lungs are always expanded by air to some extent. After ordinary expiration, from 150 to 200 cubic inches of air remain. The quantity taken in and given out, in an ordinary breath, is from 20 to 30 cubic inches; and assuming the former quantity and 18 respirations in the minute, this will give 518,400 cubic inches, or 300 cubic feet of air exchanged in twenty-four hours. But if the body were to remain at rest

during the whole of that time, the consumption of air would not be so great.

219. Of this 300 cubic feet of expired air, 4.3 per cent., or 12.9 cubic feet, is carbonic acid gas; and this contains a little more than 6 ounces of solid carbon. In a state of activity 10½ ounces of carbon are eliminated from the lungs and skin of an adult male in twenty-four hours, and if the apartment occupied by the individual be so close as to prevent any renewal of air, he would require very nearly 2,000 cubic feet of air for the twenty-four hours; so that if a man were shut up in a perfectly close apartment, opened only once every twenty-hours, he ought to have this space allotted to him. On the same principle, a close bedroom occupied during a night of eight hours, ought to have nearly 700 cubic feet of air for each adult male occupant. This space may be safely curtailed where sufficient ventilation is practised; but that allotted to each adult during twelve hours, whether by day or night, ought not to fall greatly short of 1,000 cubic feet, that is to say, a cube 10 feet in every dimension (the quantity stipulated for the prison-cell by Howard). In buildings for the reception of the sick, this quantity should be increased at least one-half. In apartments occupied for shorter spaces of time, 75 cubic feet per hour would be a sufficient allowance.

220. The air drawn into the lungs at each inspiration has been just taken at 20 cubic inches; but the quantity is variable, ranging from a minimum of 12 to a maximum of 40 cubic inches.

221. According to the lowest estimate, the carbonic acid formed in twenty-four hours amounts to 14,930 cubic inches, or 8,534 grains; according to the highest, to 39,600 cubic inches, or 18,612 grains. The mean of the three estimates (Lavoisier and Sequin, Davy, and Allen and Pepys) is nearly 28,736 cubic inches, or 14,985 grains. The quantity of carbon removed from the blood will therefore be, according to the lowest estimate, 2,820 grains, according to the highest, 5,148, and the mean of the three estimates will give 4,273 grains, or nearly 10 ounces avoirdupois. Liebig found that an adult taking moderate exercise expires daily from the lungs and skin an average of 13.9 ounces of carbon.

222. *Cœteris paribus*, the quantity of carbonic acid formed is proportionate to the activity of the respiratory function. It follows that more is formed during the day than at night; that less is formed in females than in males; in young than in middle-aged persons; that it is increased by repletion and exercise, lessened by fasting and rest. It is also diminished by depressing passions, by fatigue, by spirituous liquors, tea, or vegetable food; and it is given off in larger quantity when the barometer and thermometer are low.

223. The water exhaled from the lungs in twenty-four hours amounts, according to different estimates, to from 2,880 to 13,704 grains, or from about 6½ ounces to 1 pint 11 ounces.

224. The chief function of the lungs, then, is to free the blood from carbonic acid and water. The separation of carbonic acid, and the ab-

sorption of oxygen, are necessary to enable the blood to nourish the body, and to act as the efficient stimulus to all its functions. The suspension of breathing for a few minutes is fatal to life, and the circulation of blood not purified by respiration has an injurious influence on all the organs, but particularly on the nervous system.

225. The carbonic acid exhaled from the lungs is greatly increased in the first stage of small-pox, measles, and scarlatina, as well as in various chronic diseases of the skin, but diminished in typhus fever.

226. The lungs also serve as channels through which many volatile matters taken into the stomach escape almost unchanged; and the sweet breath of some healthy persons and the tainted breath of cachectic patients proves that those organs may also serve as avenues through which volatile matters formed within the system, and circulating with the blood, find their way out of the body.

227. *The Sweat.*—The *Skin* performs two important functions; it is a respiratory organ, and as such is a necessary aid to the lungs; and it is an exhalant organ regulating the heat of the body by the amount of evaporation from its surface, and thus acting as an aid to the kidneys.

228. The chief constituents of the sweat are carbonic acid, urea, lactates, chlorides, sulphates, and phosphates of the alkalies. Excepting after free perspiration, the sweat is acid from the presence of acetic, butyric, and formic acids. The proportion of solid matter varies from 4 to 12 parts in 1,000. The quantity of urea was estimated in the case of Funke at 157 grains in twenty-four hours; and this may probably be taken as the maximum amount. In disease, uric acid, sugar, and biliary coloring matters are present.

229. The carbon eliminated by the skin in twenty-four hours varies according to the activity of the skin from 60 to 120 grains, being about a forty-eighth of that excreted by the lungs. In common with the other excretions it is increased by moderate excitement of the circulation, and diminished by rest.

230. The exhalation of water from the skin varies greatly: 7 ounces may be taken as the average in twenty-four hours. It is increased by a dry and warm atmosphere, by air in motion, and by diminished pressure of the air; lessened by moist and still air, and by increased atmospheric pressure.

231. The perspiration is *diminished* when the watery constituents of other secretions are greatly increased; thus the skin is dry in diarrhœa, diabetes, cholera, and dropsy. It is also diminished in the cold stage of intermittent and continued fevers, and at the commencement of all febrile affections, as well as in acute inflammations, in the hot stage of fever, and in the febrile exanthemata. In the first class of cases a small quantity of blood circulates through the vessels of the surface; in the second, the circulation is increased beyond the secreting point.

232. On the other hand, the perspiration is *increased* in the sweating stage of intermittent fevers; in mild continued fevers; in catarrhal, mili-

ary, and rheumatic fevers; and in inflammatory affections of moderate severity. It is also increased whenever determination of blood to the skin is combined with debility of the capillaries, as in the hectic fever of phthisis, and other exhausting maladies: and in extreme debility the perspiration is augmented through the mere weakness of the capillary vessels. Such are the cold sweats of collapse and of death.

233. Local perspiration may be taken generally as the result of a co-extensive paralysis of the sympathetic (vaso-motor) nerves.

234. The *odor* of the sweat is due to lactic and acetic acids, and to an animal matter, which the axillary glands are chiefly concerned in eliminating. The sour odor predominates in some, the animal odor in others. The first is heightened in catarrhal, rheumatic, and arthritic diseases, in childbed, and in intermittent fevers; the last by strong exercise, by mental emotions, and in certain diseases, as pulmonary consumption.

235. Remedies act on the skin chiefly through the circulation, some by diminishing, others by increasing the heart's action. The passions of the mind also affect the secretion from the skin, by exciting or depressing the action of the heart, agreeable emotions producing a warm, moist glow, the stronger depressing emotions, copious cold sweats.

236. *The Urine.*—The kidneys subserve the twofold purpose of relieving the system of excess of water, and of removing (in suspension or solution) solid matters which have been taken as food, or have resulted from the disorganization of the nervous and muscular tissues. These last occur under the form of urea and uric acid, and of certain sulphates and phosphates. The urine is also a channel for the removal of medicines and poisons.

237. The quantity of urine excreted in twenty-four hours varies according to the activity of the skin; 48 ounces is about the average. Whatever the quantity, it should contain about 1 ounce of urea.

238. The most important constituents of urine are water, urea, and uric acid. The two latter ingredients consist of the following elements:

	Nitrogen.	Carbon.	Oxygen.	Hydrogen.
Urea, ...	47	20	27	7
Uric acid, ...	31	40	27	2

Urea contains so large a proportion (nearly fifty per cent.) of nitrogen that it is the principal means by which the transformed nitrogenized constituents of the food are eliminated. The quantity excreted is dependent on the food; being increased by animal, and diminished by vegetable, diet. Uric acid is only important when it is in excess.

239. The quantity of the urine is increased by the suppression of other secretions, and lessened by their increase; and this is especially true of the cutaneous exhalation. As the urine attracts special attention at the bedside, it will be more minutely examined in the next chapter.

240. *The Bile.*—This secretion has been well described as a soapy solution of two peculiar fatty acids combined with soda, forming the so-

called glycocholate and taurocholate of soda. These, dissolved in about nine times their weight of water, constitute about nine-tenths of the solid constituents of the secretion, every hundred parts of which contain 64 of carbon, 9 of hydrogen, 3 of nitrogen, and 24 of oxygen. The quantity of bile formed in twenty-four hours has been estimated at from 17 to 54 ounces. If, in the absence of precise data, we take the quantity at 1 pint, and suppose it to weigh 9,000 grains, it follows that, as the solid constituents form one-tenth of the entire secretion, their weight will be about 900 grains. As, again, nine-tenths of these solid constituents consist of taurocholic and glycocholic acids, it follows that about 810 grains of these acids are secreted daily. Now 64 parts in 100, or rather more than three-fifths of this, consist of carbon. This will give for the carbon contained in the bile nearly 520 grains ; and as the bile daily voided with the fæces does not contain more than a scruple of solid matter, upward of an ounce of carbon must find its way into the intestines, to be absorbed and carried into the circulating system as prepared fuel for the lungs (§ 173 *et seq.*).

241. The general surface of the large intestine, in addition to its absorbent function, probably takes an important part in eliminating noxious matters from the blood ; and the post-mortem appearances present in and near the cæcum, both in man and animals, in cases of poisoning by antimony, arsenic, and mercury, as well as in typhoid fever, point to that part as the seat of greatest activity in the elimination of poisons, whether introduced from without or generated within the body itself.

242. The functions of the lungs, skin, kidneys, liver, and bowels, by which the blood is freed from useless or hurtful matters, have now been examined separately ; but they should also be considered collectively, that the share each takes in removing effete matters from the blood may be clearly understood.

243. An average of fourteen experiments made by Dalton on his own person, on successive days in the month of March, gave the following results, the urine and fæces being ascertained by weight, and the secretions of the skin and lungs by calculation.

The ingesta and egesta both weighed 91 ounces. The egesta were as follows :

Urine, $48\frac{1}{2}$ oz. ; exhalation from the lungs and skin, $37\frac{1}{2}$ oz. ($30\frac{3}{4}$ oz. by the lungs, and $6\frac{3}{4}$ oz. by the skin) ; fæces, 5 oz. : *i.e.*, more than half by the kidneys ; a third by the lungs ; a thirteenth by the skin ; and an eighteenth by the bowels.

244. The bulk of these excretions, and consequently of the food and drink by which they are supplied, consists of water. Of the 91 ounces, no less than 76 consisted of water, which was contained in the several excretions in the following proportions :

Urine, $45\frac{1}{4}$ oz. ; lungs, $20\frac{1}{2}$ oz. ; skin, $6\frac{1}{2}$ oz. ; fæces, $3\frac{3}{4}$ oz. Total, 76 oz. ; or, about five-eighths by the kidneys ; a fourth by the lungs ; a twelfth by the skin ; and a twentieth by the bowels.

245. The separation of water is evidently an important office of the lungs and skin, and it is easy to understand how one of these organs may become vicarious of the other in this respect. Thus, when the exhalation from the skin is increased by exercise or by any other cause, the urine is diminished; when, on the other hand, as in diabetes, the flow of urine is increased, the skin becomes dry and harsh. The functions of the lungs and skin are also closely connected. When, during exercise, the skin is moist, the respiration is free; but if, the skin being dry, the circulation is at the same time excited, the respiration is oppressed; but the moment moisture breaks out on the skin, the lungs are relieved as by a charm, and respiration becomes natural and easy. The pedestrian will recognize the truth of this statement. It is the rationale of the "second wind" of those who take strong exercise.

246. The quantity of water removed by the bowels being comparatively small, has little effect on the other secretions; but if increased by the operation of a purgative, the urine is diminished, and in violent diarrhœa, and in cholera especially, it is often entirely suppressed. The exhalation from the lungs is also probably affected by the quantity of the secretions poured out by the other organs.

247. Next to the water thus removed from the system, the most abundant material is carbon. It is eliminated by the different organs in the following proportions:

Lungs, $10\frac{1}{4}$ oz.; skin, $\frac{1}{4}$ oz.; urine, $\frac{1}{2}$ oz.; fæces, $\frac{1}{2}$ oz. Total, $11\frac{1}{2}$ oz. Hence the blood is freed from its carbon by the lungs, kidneys, skin, and liver; and the lungs excrete so much the larger proportion, that no single organ, nor all jointly, can supply their place when their functions are much embarrassed. Some of the carbon contained in the fæces is furnished by the bile. The rest has never formed part of the circulating fluid.

248. The lungs and skin excrete carbon, with oxygen, as carbonic acid; the kidneys, with nitrogen and oxygen, and a small proportion of hydrogen, as urea and uric acid; and the liver, with oxygen, hydrogen, and comparatively little nitrogen, as cholic and glycocholic acids. As the carbon is similarly combined in the secretions of the lungs and skin, it is easily seen how the functions of the skin may become vicarious of those of the lungs. The relief afforded to the lungs during exercise by free perspiration probably arises in part from the excretion of carbonic acid; and the same may be said of the colliquative sweats in phthisis.

249. The close relation existing between the functions of the liver and lungs is proved by the frequent coexistence of diseases of those organs: that the one may be vicarious of the other is shown by the large size of the liver in the fœtus.

250. The essential constituent of the urine (urea) contains carbon in considerable quantity. It is directly derived by oxidation from uric acid, which contains twice the quantity of carbon, and is regarded as a product intermediate between the effete nervo-muscular tissues on the one hand,

and urea on the other. Disordered function of the lungs or skin leads, therefore, to the accumulation of uric acid in the system.

251. Nitrogen in small and variable quantity is at one time absorbed, at another exhaled, by the lungs and skin. The appropriate organ for its removal from the system is the kidney. In uræmia the stomach attempts the elimination of urea.

252. The secretions of the skin, kidneys, and liver abound in the ordinary salts; so that one of these organs may, to a certain extent, become vicarious of another. Certain saline substances are accumulated in large quantity in diseased organs at the expense of some secretion of which they form a normal constituent. Thus common salt, found in excess in the sputa from inflamed lungs, but absent from the urine, is restored to the urine on the subsidence of the disease, as has been shown by Dr. Beale.

253. In the similarity of the matters excreted by the several organs we recognize a provision for maintaining the normal constitution of the blood under slight functional disorders; while the efforts of one organ to supply the place of another probably account for some of the familiar symptoms of disease. When these efforts are unavailing, the blood becomes seriously altered, to the imminent danger of the patient.

254. The following table presents at one view the result of Dalton's experiments; the last three lines being rude approximations:

	Pulmonary exhalation.	Cutaneous exhalation.	Urine.	Fæces.	Total.
	oz.	oz.	oz.	oz.	oz.
Egesta,	30¾	6¾	48½	5	91
Water,	20½	6½	45½	3¾	76¼
Solid residue,	10¼	¼	3	1¼	14¾
Consisting of substances containing—					
Carbon,	10¼	¼	½	½	11½
Nitrogen and other gaseous elements of urea and uric acid, exclusive of carbon,			1½	..	1½
Salts, etc.,			1	..	1
Residue of undigested matters,				¾	¾

255. In the foregoing statement and tabular summary no notice is taken of the large quantity of oxygen received through the lungs. This gas, as essential to the support of the frame as food itself, by uniting with the effete textures, gives rise to compounds which cannot support life, and these being absorbed into the current of the circulation, seek their exit from the body through the excreting organs. If we suppose the weight of the body to remain unchanged, the oxygen introduced by the act of respiration, added to the food consumed, must equal in weight the matters rejected by the excreting organs. The part borne by each organ in this work of elimination is shown in the following table, which embodies

the figures of two tables given by Vierordt in his "Grundriss der Physiologie," p. 192. 3,952 grammes of food and drink are resolved into their elements, and traced, so to speak, into the excretions through which they pass from the body.

Received as Food.	Grammes.	Excreted by				
		Lungs.	Skin.	Kidneys.	Bowels.	?
Water in food and drink,	2,818	330	660	1,700	128	..
Oxygen (from air 744, from food 38), . .	782	651	7	11	12	101
Hydrogen from food, .	19	..	..	3	3	13
Carbon, " " .	282	249	3	10	20	..
Nitrogen, " " .	19	..	..	16	3	..
Salts, " " .	32	..	..	26	6	..
	3,952	1,230	670	1,766	172	114

With the exception of 101 parts of oxygen and 13 of hydrogen, supposed to unite as water, the watery, gaseous, and saline elements of the food are here traced to the organs by which they leave the body. It is worthy of remark that in the experiments from which these figures are deduced, the oxygen received in respiration is little less than a fifth part by weight of all the solid and liquid matters taken as food, and very nearly twice as great as the oxygen, carbon, hydrogen, nitrogen, and salts contained in all that part of the food that is not water.

2. PHYSIOLOGY AND GENERAL PATHOLOGY OF THE CIRCULATING SYSTEM.

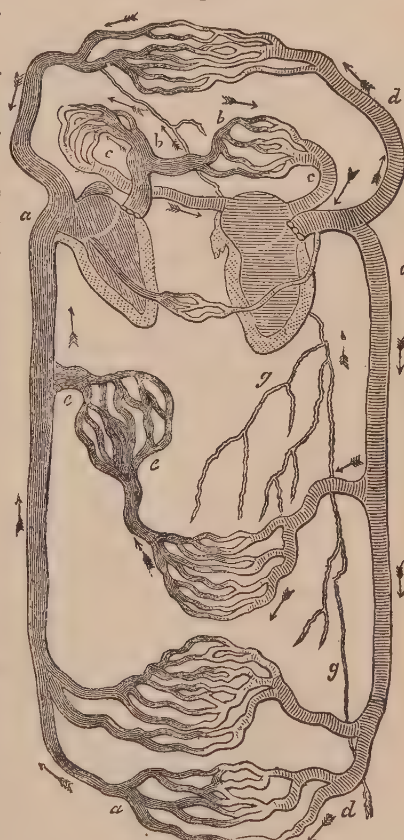
256. Having now examined the function of digestion; the blood, and its constituents; the secretions destined to further uses; and the excretions by which the blood is freed from useless or hurtful matters; it remains to consider the mechanical arrangements by which the blood is renewed, purified, and distributed through the frame; in other words, to examine the functions of absorption, secretion, nutrition, and circulation. This will be done in the following order: the action of the heart; the motion of the blood in the arteries; the function of the capillaries, of the veins, and of the absorbents.

257. *The Circulation.*—The heart is the centre of two incomplete circulations; one through the lungs, beginning at the right ventricle, and ending at the left auricle; the other through the body, commencing at the left ventricle, and ending at the right auricle; the two together forming a complete circulation, an uninterrupted stream of blood. A third circuit consists of the coronary arteries springing from the commencement of the aorta, and the coronary vein opening into the right auricle.

258. These three incomplete circulations consist of vessels, all of which are always, and in all states of the living body, full of blood, though more or less distended as it is increased or lessened in quantity.

259. The vessels in question consist of an arterial trunk split into numerous small branches, of a venous trunk formed by the union of equally numerous small veins, and of capillary vessels uniting the two, and this—arteries dividing into small branches, and corresponding small veins uniting to form venous trunks—is, with the exception of the vena portæ, and the minute vascular system of the kidney, the mechanism of the circulation throughout the body.

Fig. 3.



260. A general view of the circulation, including the portal system, is given in Fig. 3, in which *a d* represents the circulation through the body, *b c* the circulation through the lungs, *e e* the exceptional portal system, and *g g* the lymphatic and lacteal system. The darker parts of the plan, to the left of the diagram, represent the venous system, and the lighter, to the right, the arterial system. The arrows indicate the direction of the stream of blood. The circulation through the heart is apparent without the use of letters.

261. *The Heart's Action.*—The *heart* is the source, and chief cause, of the circulation through the blood-vessels. The ventricles, expelling their contents with more or less frequency and force, in different persons, and in the same person at different ages and at different times, send out at each contraction the blood received into the auricles from the large venous trunks.

262. The average number of contractions in a minute may be set down at 70 for an adult male, and 80 for an adult female. The quantity of blood forced into the aorta at each beat of the heart in a healthy adult has been variously estimated at from 2 to 5 or 6 ounces; and the total quantity contained in the body at about 20 pounds (§ 189).

263. The force with which the blood is expelled by the left ventricle has been estimated at somewhat more than 4 pounds: that by the right at about 2 pounds.

264. The time required for the complete circulation of the blood through the right side of the heart, the lungs, the left side of the heart, and the whole of the blood-vessels, from a given starting-point to the corresponding goal, say from one jugular vein to another, is about half a minute. This is readily proved by the injection of such salts as ferrocyanide or iodide of potassium. Hering found that the transit of the former of these substances from the jugular vein to the metatarsal artery occupied twenty-five seconds in one experiment, and forty in another.

The circulation is most rapid in the arteries, and least so in the capillaries, the rate, of course, diminishing as the sectional area of the vessels increases. Volkmann concludes that the blood moves 12 inches in a second in the aorta, and Vierordt $2\frac{1}{4}$ inches in the same space of time in the arteries of the foot, while the rate in the capillaries is not greater than 1 inch in a minute, the force of the circulation in medium-sized arteries, such as the radial, being equal to about 4 drachms. Valentin has calculated that the whole of the blood in the body passes through the heart in from forty-three to sixty-three seconds.

265. *The Arteries.*—The blood sent out by the heart is distributed to every part of the body by the arteries. The larger arterial trunks are highly elastic tubes, destitute of muscular fibre, admitting of expansion, both transverse and longitudinal, and able to adapt themselves to the volume of their contents. With each contraction of the heart they are expanded and slightly curved; and Poisseuille has shown that they undergo an increase of size, amounting, in the carotid artery of the horse, to $\frac{1}{23}$d of its capacity.

The larger arteries, by yielding to the impulse of the blood and reacting upon it, cause a delay in its motion which would not occur in rigid tubes; hence the pulse is somewhat later in the arteries remote from the heart than in those near it. This elasticity also equalizes the motion of the blood in the smaller vessels, and causes it to flow in an even stream. It also accounts for their empty state after death, their contents being forced into the veins. In old age this property is lost through degeneracy or ossification.

266. In dilating, the artery is stretched and curved outward by the forcible injection of blood; and if the finger be applied to it with a tolerably firm pressure, this effort at change of place is felt. But this is not all; for the pressure of the finger is resisted by the blood forced into the artery; and this resistance is also felt. These two things together, the change of place, and resistance to pressure, constitute the pulse, which will be more minutely examined in the next chapter.

267. The smaller arteries and veins have layers of muscular fibres, in the former arranged circularly, and in the latter in two sets, an inner circular, and an outer longitudinal. In cases of obstructed circulation these muscular fibres have been found hypertrophied. The effect of the functional derangement of a single organ in causing hypertrophy of the whole vascular system, including the heart itself, has been demonstrated by Dr. George Johnson, in chronic inflammation of the kidney (see chronic ne-

phritis). The arteries intermediate between the large trunks and their smaller branches, have more or less muscular fibre as they approach to the one or the other class of vessels.

268. *The Capillaries* are vessels of extreme minuteness, consisting of a single membranous coat, through which the portion of the blood destined for secretion or nutrition finds its way. They form a network, between the meshes of which the proper substance of each organ lies, or they are so disposed as to adapt themselves to the form and arrangement of the several tissues; and they establish a communication between the last divisions of the arteries and the first of the veins. The small arteries which do not lose themselves in veins have no other termination, and the veins no other origin; and there are no vessels terminating by open mouths. This continuity of the arterial and venous system through the intervention of the capillaries is shown in the annexed engraving of a villus, of the small intestine (Fig. 4), in which the shaded vessels represent the veins, and those in outline the arteries.

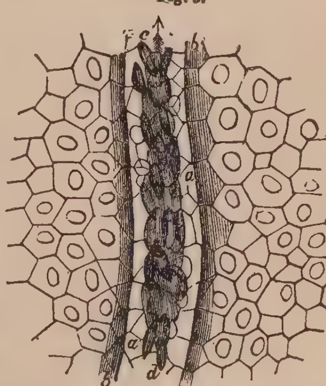
Fig. 4.

269. The motion of the blood is mainly due to the heart's action; its constant and equable flow to the elasticity of the arterial trunks. The capillary circulation is excited by the attraction of the tissues for arterial blood; while the onward flow of blood in the veins is secured by the active dilatation of the heart, and the inspiratory act, which sucks the blood into the lungs; as well as by the muscular walls of the vessels. The motion of the blood is slow in the capillaries, owing to the greatly increased area over which the blood is distributed when it enters the capillaries—an area which, compared with that of the arteries supplying them, is as 800 to 1.

270. In health, the capillaries subserve the important function of nutrition by allowing the ready exudation through their thin membranous wall of the materials which the several tissues require for their growth and repair; and in disease they play an important part in the changes known as *inflammation, irritation,* and *congestion.*

271. The minute arteries and capillary vessels are subject to changes in health, which enable us to understand disease. Shame brings a blush to the cheek; fear blanches it. Warmth and exercise redden the skin; cold and continued rest deprive it of color. These effects depend on variations in the calibre of the small arteries and capillary vessels.

Fig. 5.



272. Such variations may readily be observed in the vessels of the frog's foot (Fig. 5).

The velocity of the circulation is seen to increase, the outer portion, *a a*, of the calibre of the vessels to admit red particles, *c d*, and the size of the vessels, *b b*, to increase or decrease.

273. In the examples just adduced we have three distinct causes of determination of blood to the skin: in the first an emotion of the mind; in the second, a local application to the vessels; in the third, the increased action of the heart. From the first example it appears that the state of the small vessels may be changed without increased action of the heart, for if the enlargement were due to that cause, the blush would not be confined to the cheek; from the second, that local applications will affect them in the same way; and from the third, that the same result may follow from the stronger and more frequent contraction of the heart itself. The cases in which pallor of the skin occurs are equally instructive, proving as they do the local effect of emotion in contracting the small vessels, the equally local effect of cold, and the remote effect of a quiet action of the heart.

274. In the effects of emotion and of stimulating local applications we have examples of the active dilatation and contraction of the capillaries independently of the heart's action, and therefore solely due to nervous influence.

275. The rate of the circulation in the capillaries is, however, determined by the state of the small arteries on the one hand, and the greater or less vigor of the processes of secretion and nutrition on the other.

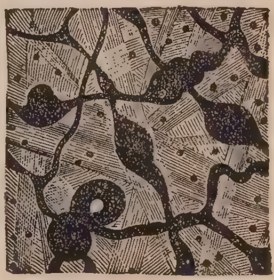
276. It appears, then, that, in one instance at least, the enlargement of the minute arteries is only to be accounted for by a diminution or suspension of their contractility. Now, this same enlargement of the small arteries occurs in inflammation. Is it due to the same cause? A grain of sand gets into the eye, and in a short time the vessels of the conjunctiva become filled with red blood, and enlarged, obviously without any increased action of the heart, for the other eye equally affected by the general circulation, is not inflamed. Again, the immediate effect of ice applied to the finger is to contract the vessels; but no sooner is it removed than the pale skin resumes its color, and becomes even redder than the surrounding skin. This change, too, is strictly local, and independent of the heart's action. The same contraction of the small arteries, followed after a variable interval by dilatation, has been shown, by experiments under the microscope, to follow the application of mechanical and chemical irritants. So that it may be stated as a general fact, that the agents which excite inflammation may first cause contraction of the small vessels, and that this contraction is followed by dilatation.

277. These actions take place in obedience to a general law, that stimuli applied to any part of the body, acting through its nerves, develop the special functions of that part for a time, but that the nervous force suffers an exhaustion proportionate to its intensity and duration, and results in a condition the very reverse of that which existed when the stimuli were first applied. In the case now under consideration the stimulus first excites the contractility of the small arteries; after a time exhaustion ensues, the

vessels expand, and become unduly loaded with blood. When the exhaustion is complete, the vessels are distended and stagnation ensues.

278. During this first period of contraction the flow of the blood is retarded; but when the vessels become dilated, the circulation is accelerated, to be again retarded after an interval of time. The small vessels, in becoming dilated, are also stretched and twisted, and here and there even become varicose, as is shown in the annexed engraving from Valentin, after Harting (Fig. 6). In consequence of this increase of size, the vessels admit a larger number of red particles; and those that previously conveyed only colorless blood now become carriers of red blood.

Fig. 6.



279. The changes that occur in an inflamed part are not long confined to the small vessels. The larger arteries and veins suffer the same dilatation; and if the inflammation prove severe and extensive, the arterial trunks themselves participate: and thus large portions of the body—a hand, a foot, a limb, or an internal organ—become so many congeries of enlarged vessels containing more blood than those of the corresponding part of the body. An inflamed hand, for instance, contains much more blood than the sound one; its radial artery is evidently enlarged, through loss of contractility and increased action of the heart; and if a vein of that side be opened, it will pour forth much more blood than the vein of the opposite side.

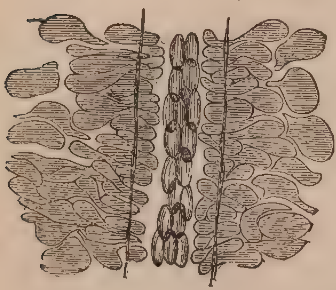
280. Through the increased action of the heart, which occurs in all acute inflammations, blood is sent in greater quantity to every part of the frame, and gives rise to *symptomatic fever*, converted, if the nervous system suffer much, to the state known as *irritation*, *constitutional irritation*, or *irritative fever;* should the power of the constitution have been previously exhausted, the fever may assume the *typhus* type in place of the milder form it assumes in the strong and robust.

281. It appears, then, that in acute inflammation the propelling and regulating action of the small arteries is diminished or annulled, and instead of aiding the circulation they are an impediment to it. The heart is called upon to overcome the obstruction, and hence the greater force and frequency of its pulsations.

282. Such being the general state of the circulation in inflammation, our attention must now be directed to the process as it affects the capillaries, because these and the tissues in which they lie are the parts most directly and severely implicated in the morbid action. The following important observation is due to Cohnheim. If the mesentery of a living frog be stretched over a ring of cork, and magnified about 100 times, the vessels are seen to dilate and the colorless blood corpuscles to begin to collect and adhere to the inner surface of the wall of the capillaries. Little budlike processes of these corpuscles are then protruded through the wall of the

vessel, and increase as the corpuscle on the inside diminishes, until at last the corpuscles pass entirely from the interior to the exterior of the tube. Having passed through the cells by virtue of the independent movements they possess (see Fig. 7), they leave the wall of the vessel and wander into and among the interstices of the surrounding tissue. Irritation of a particular point determines the direction which they take, and here they accumulate and form a mass of exudation or formative tissue, which becomes the point of departure of all future changes. Simultaneously the tissue itself undergoes a change; the corpuscles of the connective tissue multiply, and the fibres of a compact part are pushed apart and become loosened and absorbed in proportion as the exudation increases and occupies its meshes. Thus it is that we find the vessels in an inflamed part embedded far and wide in young cellular growths.

Fig. 7.



283. The effect of the inflammatory action on a free surface is well illustrated in the serous membranes and uriniferous tubules. The liquor sanguinis escapes with the colorless corpuscles, coagulated fibrin is intermingled with the formative cells, and the serum separates to form a fluid effusion.

284. When a gland is implicated in the inflammation, the first effect is a diminution of the appropriate secretion, and this is quickly followed by the rapid destruction of the secreting cells, and the retention of the constituents of the secretion in the blood, and thus general blood poisoning is in such a case the necessary consequence of inflammation. An excellent illustration of these facts is afforded by inflammation of the kidney. First the urine is notably diminished, this is followed by a rapid desquamation of the epithelial cells lining the urinary tubes; the detached cells clog the tubes; and blood or serum is extravasated from the Malpighian tufts. If the inflammation be very severe and affect both kidneys, urea is retained in the blood and symptoms of narcotic poisoning soon ensue. A train of symptoms very similar in the main follows acute inflammation of the liver (see Yellow Atrophy of the Liver).

285. The enlargement of the small vessels in inflammation, then, is quickly followed by effusion. When the skin is inflamed, as by a burn, serum is thrown out from the surface under the cuticle, and a blister rises; when a mucous or serous membrane is inflamed, fluid exudes from its surface; when the cellular membrane is attacked, the fluid is poured into its cells. This effusion varies with the constitution and state of system, the condition of the part, and the intensity and nature of the inflammation; and may present every variety between a lymph abounding in fibrin, and a lymph rich in granules or corpuscles.

286. The lowest degree of inflammation merely increases the watery

secretion of the part attacked—of serum, in the case of serous membrane—of mucus, when a mucous surface is inflamed. A higher degree of inflammation causes the effusion of solid matter or formative material. The increased secretion of the serous membranes is *dropsy*, or, when of limited extent, *œdema;* that of the mucous membranes, *flux*. Both these membranes, also, when, the inflammation is more intense, pour out lymph or pus. In the former case the inflamed surfaces of the pleura or peritoneum become glued together, and the effused matter, becoming organized, forms permanent adhesions. The mucous membranes, too, when highly inflamed, pour out lymph of such tenacity as to assume the shape of the tubes which they line, and even to be mistaken for the detached lining membrane itself. This occurs in the larynx, in diphtheria and croup; in the bronchial tubes, in a peculiar form of bronchitis; in the intestines, in dysentery; in the kidneys, in inflammatory affections of those organs. Of purulent effusion from serous membranes, empyema is an example; and of the formation of pus by mucous surfaces, purulent ophthalmia.

287. When the small vessels return to their natural size, and any effusion (that may have taken place) into the surrounding textures is absorbed, the inflammation is said to terminate by *resolution;* when blood is thrown out, by *hemorrhage;* when serum, by *effusion;* when fibrin or lymph is formed and organized, by *adhesion;* when pus is effused, by *suppuration;* when the part dies, by *necrosis* or *gangrene.* Inflammation of mucous surfaces, or of exposed portions of cellular membrane, accompanied by the effusion of pus, and the more or less rapid removal of the part affected, constitutes *ulceration;* and a similar process in the substance of organs is known as *ramollissement,* or softening.

288. The generic term inflammation is often qualified by other words indicative of its character. Thus we have *œdematous* inflammation, or inflammation terminating in, or accompanied by, *œdema; adhesive,* or inflammation terminating in *adhesion; suppurative,* or inflammation issuing in *suppuration; gangrenous,* or inflammation ending in *gangrene.* The terms *acute* and *chronic, healthy* and *unhealthy, common* and *specific, phlegmonous* and *erysipelatous,* are also used to designate varieties of inflammation.

289. When inflammation attacks the cellular membrane, whether in the skin or in the substance of internal organs, it takes different courses according to its intensity. If slight, it terminates in *resolution;* if more severe, *effusion* may take place; if more severe still, *suppuration;* if still more intense, *gangrene.* If a portion of the cellular membrane die, or if blood, serum, or fibrin be poured out so abundantly as to distend and break down the tissue, pus is formed in small detached portions, which, by solution of the intervening parts, coalesce, so as to form one single collection of purulent matter, round which a wall of fibrin or coagulable lymph is built up, becomes organized, and constitutes a *cyst* or *sac.* This collection of pus in a cavity, bounded by a wall of effused and organized fibrin, is called an *abscess*—a term which, like the word inflammation, is

qualified in practice by phrases indicative of its character or progress, such as the *acute* or *phlegmonous*, and the *chronic* abscess.

290. *Resolution.*—In order to facilitate the dispersion of the amœboid cells we apply heat, which is known to facilitate their movements; but we must remember that the untimely use of hot fomentations may encourage the issue of the cells from the capillaries, and so increase the effusion. The effusion may also be removed by fatty degeneration of its cellular constituents; for when cells cease to be active, they are rapidly invaded by fatty molecules, and ultimately soften down into a milky fluid, which is readily and completely absorbed.

291. *Suppuration.*—Pus is composed of fine granular corpuscles suspended in colorless serum in which are dissolved several forms of albumen, mucus, lecithin, glycogen, and salts; and suppuration must be regarded as the direct continuation of the inflammatory process. The pus corpuscles are derived from the multiplication of the extravasated colorless blood corpuscles and the free cells (*leucocytes*) of the connective tissue, both of which appear to be capable of unlimited reproduction as soon as blood-vessels appear in the effused products.

292. Sometimes the constitution is not strong enough to build up and organize a wall of fibrin about the dead part, and then the pus finds its way into the surrounding cellular texture, and forms a *diffused abscess*, or the inflammation is peculiar, as in erysipelas, and suppuration takes place with little or no adhesion.

293. In rare instances the pus undergoes fatty degeneration and is absorbed, and the abscess is said to be *dispersed;* but in the majority of cases fresh pus is formed, the abscess increases in size, and presses on surrounding parts, some of which yield to the pressure, and then the abscess is said to *point;* and if it is near the surface, the skin itself offering least resistance, is protruded, and stretched more and more till it bursts.

294. *Organization after Suppuration.*—When the matter of an abscess is discharged, the cavity contracts, the fibrinous lining is cast off, and the walls become a suppurating surface, on which fresh fibrin is effused. Part of this fibrin becomes organized by vessels, which either form within it, and then connect themselves with those of surrounding parts, or gradually extend into it from those parts. These newly organized portions of fibrin are arranged side by side as small rounded vascular points, called *granulations.* The fresh surface thus created secretes pus, which protects it from the air. When the granulations approach the surface, the pus hardens into a *scab,* which forms a still more efficient protection. In healthy persons the granulations are numerous, small, and florid, and coated with a creamy pus, known to the older surgical writers as *laudable* pus. Unhealthy granulations, on the other hand, are large, pale, and flabby, and discharge a thin flaky pus.

295. When the tissues are divided, and the two edges of the wound thus formed are brought close together, and kept in contact, a speedy and perfect union may take place, and the wound is then said to have been

healed by the *first intention.* But the part may not heal in this simple way: the wound may gape, and an open sore or *ulcer* be formed, presenting the same granulations as the walls of an abscess that has burst. These, once completely organized, secrete fresh lymph, and this, in its turn, is moulded into new granulations; and thus the ulcer is at length filled up to a level with the surrounding skin, and protected by a scab; a small portion of new tissue is meanwhile formed between the edges of the wound, which gradually contract as the surface heals. Ultimately the scab falls off and exposes the newly formed tissue. The *scar,* or *cicatrix,* is at first red, but the color gradually fades, and at length the scar is recognized by its whiteness.

296. As a general rule abscesses, whether in the integuments or in the solid viscera of the body, tend toward the surface; but to this rule there are exceptions. If, for instance, an abscess form in such an organ as the liver, its firm, close structure may offer more resistance than the loose texture of an adjoining intestine: the abscess presses upon its coats, and adhesive inflammation is set up between the two layers of serous membrane; the peritoneum and the coats of the intestine are thus so glued together as to form one continuous texture, through which the abscess, continually increasing, forces its way, till it bursts and discharges its contents. Sometimes the course of an abscess is more circuitous, as when an abscess of the liver finds its way through the diaphragm, and opens into the lungs. Sometimes, again, an abscess in a solid viscus discharges itself into the serous cavity which surrounds it, as when abscess of the lung opens into the pleural sac.

297. As a general rule, the matter of an abscess takes the shortest course to its place of discharge; the most common exception being in the case of collections of matter formed beneath fasciæ, by which they are bound down and directed to a distant part.

298. *Ulceration* is the result of suppuration. Ulceration of the skin, for instance, begins with inflammation, and is followed by the effusion of serum or pus, known as a vesicle or pustule. This breaks, and leaves an uneven surface, covered with flakes of lymph, and moistened with pus, which may either heal in the way just described, or extend and enlarge by the destruction of the skin and subjacent textures. In ordinary cases the parts are removed gradually, and almost imperceptibly; in others, with great rapidity, where the ulcer is called *phagedenic;* in others, again, the inflammation is so intense as to cause the death of considerable portions of the cellular membrane, in which case it is called a *sloughing* ulcer. The most rapid destruction of parts with which we are acquainted has received the name of *sloughing phagedena,* or *hospital gangrene.* Ulcers are further designated as *acute* and *chronic; healthy* and *unhealthy; inflamed, indolent,* and *irritable; congestive, varicose, fistulous, rodent,* etc.

299. *Gangrene* is one of the terminations of inflammation; and the death of a limited portion of the cellular or other texture is an occasional cause or abscess. The common *boil* is an example of a more extended

death of the cellular tissue, and *carbuncle* of the worst form of boil. But gangrene may take place without the formation of an abscess. It may attack a limb, in consequence of the extreme languor of its circulation; and, beginning in the foot, extend upward till it reaches a part where the circulation is active enough to allow of adhesive inflammation. Coagulable lymph is thrown out in a circle, dividing the sound from the dead parts; granulations are formed, pus effused, and at length natural amputation of the dead member will be effected. Thus, through the different effects produced, and the different secretions poured out in different degrees of inflammation, the body sets limits to its own diseases, and repairs the most severe injuries.

300. Gangrene may exist for a long time without inflammation, as in a limb of which the arteries are ossified, or in cases of poisoning with ergot of rye: this is distinguished as *dry* gangrene. When gangrene, from extreme languor of the circulation in the lower extremities, attacks aged persons, it is known as *senile* gangrene.

301. The most frequent constitutional or predisposing cause of gangrene is debility; the most common exciting causes are severe mechanical injury, the action of violent irritants, pressure, and intense cold. The immediate or proximate causes are a deficient supply of arterial blood, impediments to the return of the venous blood, and injury or division of the nerves. The term *mortification* is commonly used as synonymous with gangrene; and the word *sphacelus*, or *slough*, is employed to characterize a part which cannot be restored to life.

302. Further descriptions of inflammation, its causes, phenomena, termination, and the various modifications it undergoes in different states of health, in different constitutions, and in each texture of the body, will be found under the head of the various diseases to be described later.

303. *Congestion* is nearly allied to inflammation. It consists in a passive enlargement of the small vessels, without inflammatory symptoms or effusion unless it be excessive, when there is an increase of the natural moisture of the part. This enlargement of the vessels is the effect of debility; and, as such, is apt to continue in parts in which the symptoms of acute inflammation have been subdued. It is common in the aged, and in persons exhausted by disease. From its involving the veins rather than the arteries, it is often termed *venous congestion*. Pressure is a common cause of this state: hence congestion of the veins of the leg after long standing, of the vessels of the head from wearing a tight cravat, and in the lungs from hinderances to the respiration.

304. *Congestion of internal organs* is a common occurrence, and plays an important part in the development of organic disease, and in the hemorrhage and dropsy which so frequently accompany it. Some of the causes of visceral congestion, such as cold applied to the surface, a continued dry state of the skin in febrile disorders, and the plethora induced by a rich and stimulating diet combined with insufficient exercise, are very simple and obvious. The continued action of these causes leads sooner or

later to organic disease in some predisposed organ, such as the brain, the lung, the liver, or the kidney.

305. *Hemorrhage* is a frequent consequence of congestion, when it is termed *passive;* but it sometimes seems to flow immediately from the arteries, when it is termed *active.* Hemorrhage from the lungs is generally caused by rupture of an artery ; but in case of the stomach and bowels, the blood seems to exude through the coats of the vessels. Hemorrhage may also take place into the ducts of secreting organs, such as the liver or kidney. In scurvy and in putrid fevers the hemorrhage is due partly to weakness of the vessels, and partly to thinness of the blood. Hæmatemesis, melæna, and hemorrhoids are examples of passive hemorrhage. The copious discharge of red blood from the bowels, traceable by the use of the *speculum ani* to a small spot in the mucous membrane of the intestine, is a good example of the active form.

306. *Nutrition and Secretion.*—These two processes are essentially the same ; for they consist in the development of single cells endowed with independent vitality, and capable of assimilating from the blood their own peculiar fluids.

307. The *secreting organs* assume various forms ; but consist essentially of a basement membrane, lined with epithelial cells, and covered externally with a network of blood-vessels.

308. In *nutrition* each cell runs through its course of gradual development and decay, and the products of its decomposition (the first in order being, as in all forms of decay, carbonic acid) are absorbed into the blood, and discharged by appropriate excreting organs.

309. In *secretion*, too, the cells which form the essential secreting organ ripen by the absorption of materials constituting the secretion, and then break up and decay ; the mixed products being poured into tubes fitted for their reception and discharge.

310. The fluids thus poured out by the secreting organs are known as *excrementitious* and *recrementitious ;* that is to say, they are expelled as hurtful, or retained to serve some useful purpose.

311. To the class of *excrementitious* matter belong the urine, the sweat, the water and carbonic acid exhaled from the lungs, a small portion of the bile, the secretions of the mucous membranes, the menstrual discharge, and the hair, cuticle, and nails. Milk and semen, the one nutritive, the other reproductive, form a class by themselves.

312. Of the *recrementitious* secretions some (as those of the salivary glands, stomach, liver, and pancreas) subserve the process of digestion ; others (as the tears, and the watery secretion of the Malpighian tufts of the kidney) cleanse the surface of the eye and the urinary tubes respectively ; others again (as the sebaceous secretions of the skin, the mucus of the mucous membranes, and the aqueous secretion of the serous membranes) protect the parts which they moisten from injury, and facilitate their movements.

313. Another secretion not destined to immediate expulsion from the

body consists of the fat deposited in cells of the adipose tissue, giving roundness to the form, facilitating motion, protecting the body against changes of temperature, and serving as a store of nourishment.

314. Of secreting organs in the membranous form the serous membranes (the pleura, peritoneum, arachnoid, and the synovial membranes of joints, etc.) are examples, as well as the mucous membranes (that lining the mouth and nostrils, the windpipe and lungs, the alimentary canal and the parts communicating with it, and that lining the urinary passages and organs of generation). The skin is a compound organ, containing odoriferous, sudoriferous, and sebaceous glands.

315. *Glands*, in the usual acceptation of the term, are of three kinds—1, collections of blood-vessels, as the spleen and placenta; 2, similar congeries of lymphatic vessels (lymphatic glands); and 3, true secreting organs. These latter possess an excretory duct, which, traced backward from its trunk, divides, like the root of a tree, into fine branches, of which the smallest terminate in blind extremities of various shapes, called follicles, acini, tubules, etc. On the outside of these minute terminations the capillaries ramify, and the appropriate secretion is abstracted from the blood by the secreting cells which line the passage, where the branches of the duct end, and it is then shed by these into the duct, and distils from its orifice. The blood thus freed of the secretion passes onward to the heart.

316. In the kidney, the secreting apparatus is more complicated, consisting of a tuft of vessels (the Malpighian body), which secrete water, and tubes lined with epithelium, which eliminate the solid constituents of the urine. The water serves to wash out these solid matters—an operation assisted, in reptiles and fishes, and probably in mammalia also, by the cilia which line a portion of the tubes.

317. Secretion, like nutrition, is subject to differences in degree and in kind. The natural secretion of a part is augmented by increased flow of blood, provided it be not excessive. Thus perspiration follows exercise, and free action of the bowels irritation of the intestinal mucous membrane. Secretion may also be increased by debility of the small vessels, when the circulation is languid, as in the cold sweats following a faint, or preceding dissolution. These two causes of increased secretion—augmented flow of blood, and weakness of the vessels—combine to produce the night-sweats of hectic fever. On the other hand, the natural secretion of a part is diminished when the supply of blood is either unduly lessened or augmented, as is the case with the skin both in the cold and in the hot stage of fever. In this latter case, as soon as the fever subsides, and the quantity of blood sent to the skin falls to a certain point, sweating begins. The nerves, too, have great effect on the secretions, as is seen in the flow of tears from grief, joy, or rage, and in the effects of fear or anxiety on the skin, kidneys, and bowels. Mental emotion, however, checks some secretions. Thus fear, which increases the secretion of the skin, checks that of the salivary glands.

318. But the secretions vary in *kind* as well as in degree; in other words, they are liable to morbid changes. Thus, the serous membranes, which in health secrete a watery mist or vapor, under a certain degree of inflammation pour out serum, and dropsy results; under a higher degree liquor sanguinis is poured out; under a different kind, and perhaps higher degree, pus. The mucous membranes, according to the amount of inflammation, secrete a glairy fluid, tough mucus, pus, or fibrin, or all these secretions blended in different proportions, as may be observed in the course of a severe attack of catarrh.

319. Serious consequences result from the suppression of secretions, or from the non-elimination of some of their important constituents. The rapidly fatal result of acute atrophy of the liver is due to the suppression of the bile; and alarming symptoms of uræmia follow the retention of urea in diseases attended by suppression of urine.

320. What has been said of the similarity of structure in the several secreting organs will prepare us to view, without much surprise, the assumption by one secreting organ of the functions belonging to another. This is termed *metastatis* of secretions. The secretion of urine, or of a fluid nearly resembling it, by the skin and several of the mucous surfaces; of bile, by almost all the secreting organs, as in jaundice; of milk, by the skin and lungs; and of the menstrual flux, by the vessels of the nose, lungs, and stomach, and from the surface of ulcers, are familiar examples of this vicarious secretion.

321. *The Veins.*—The veins are larger than the arteries. They are provided with longitudinal as well as circular muscular fibres in their elastic walls. The larger veins of the extremities are provided with valves to prevent regurgitation, and give support to the blood which they contain.

322. The venous circulation is effected mainly by the impulse of the heart continued through the capillaries; but it is assisted by the contraction of the muscles of the extremities pressing the blood toward the heart. The movement of blood in the great veins near the heart is further accelerated by the act of inspiration, and partly by the suction of the heart in the act of dilatation of the ventricles.

323. At each inspiration the chest is enlarged by the descent of the diaphragm, and the elevation and tilting outward of the ribs. This tends to produce a vacuum, which is prevented by the entrance of air, of blood, or of both. That the motion of the blood in the large veins is thus accelerated is shown by experiments, and by the phenomena attending the admission of air into wounds in the larger venous trunks. It has also been shown experimentally that at each systole of the heart a tendency to a vacuum exists in the pericardium, counteracted by the blood of the large veins distending the auricles.

324. During expiration the blood is forced on by the lungs into the left side of the heart, and thus they are prepared to receive a fresh supply of venous blood from the right ventricle on the next inspiration.

325. When the right auriculo-ventricular valve allows of regurgitation,

the blood flows back into the descending cava and jugular vein, causing a *venous pulse.*

326. Poisonous substances introduced into wounds permeate the capillaries, and soon find their way into the veins. Thus directly absorbed into the circulation they act very rapidly; hence the efficacy of ligatures applied above wounds, of the abstraction of the blood below the ligature, and of the application of cupping glasses, which answer the double purpose of ligatures and evacuators.

327. *Absorption.*—This term is applied to the act of taking up into the circulation both fluid and solid matters. The capillaries may be regarded as general absorbents; the lymphatic vessels and that portion of them which is called the lacteal system as special absorbents; the capillaries taking up any surplus of fluid or formative matters that has been poured out in the process of nutrition and returning it to the general circulation, and the lacteals absorbing special nutritive material from the intestines.

328. Absorption is certainly affected in more ways and by more means than one. Living and dead tissues allow the passage of fluid and gaseous matters through them. This is called *imbibition.* If two gases are separated by a partition of moist bladder, both will permeate it till they are completely mixed. A gas, likewise, will pass through a moist bladder to mix with a fluid within it. This takes place in the lungs. Again, if a moist bladder be tied over the mouth of a vessel filled with water, a salt strewed over its surface will be dissolved by the water which permeates its pores. If a tube filled with a solution of salt or sugar, and closed by a bladder, be placed in water, the water permeates the bladder, mixes with the solution, and rises in the tube. At the same time, part of the fluid contained in the tube traverses the bladder in an opposite direction, and this interchange takes place till the fluids on both sides have become homogeneous. If the arrangement be reversed, so that the denser liquid is outside the bladder, and the rarer liquid in the tube, the liquid in the tube passes through the bladder, and gradually sinks to a lower level. These phenomena constitute the "endosmose" and "exosmose" of Dutrochet. Lastly, if a vessel made of vegetable parchment, or other permeable material, filled with a liquid consisting of animal, vegetable, or mixed matters holding some salt or metallic oxide in solution, be floated on the surface of distilled water, the salt or metallic oxide will traverse the membrane and lose itself in the water, the glutinous and uncrystallizable matters remaining behind. To this process, devised by Graham, the term *dialysis* has been applied. These processes of *imbibition, endosmose* and *exosmose,* and *dialysis,* bear important parts in the work of absorption.

329. Matters in solution pass into the capillaries, and thence into the veins by the process of "endosmose," which goes on the more rapidly as the denser fluid (the blood) is no sooner diluted than it gives place to a fresh portion, and thus endosmosis into the blood takes place more completely, and goes on more constantly, than into fluids at rest. The alkalinity of the blood also aids the absorption.

330. This process of absorption is very rapid. In a part free from epidermis it is almost instantaneous; and minute portions of fluid, or of substances held in solution, may be absorbed, and distributed through the body in from less than half a minute to two minutes. In this way the rapid action of the more energetic poisons is explained; and it is only in rare instances, if in any, that a different explanation is needed.

331. The rapidity with which absorption takes place is shown by the passage of certain salts from the stomach to the kidney. In one experiment made by Westrumb, prussiate of potash was detected in the urine after two minutes; and in the history appended to a cast of the Epispadian Arburg, in the museum of King's College, it is stated that fluids may be seen trickling from the ureters into the bladder in from two to three minutes after they have been swallowed.

332. Several agents affect the rapidity with which imbibition and absorption take place. Of these galvanism is the chief. Thus, Foderé showed that when a solution of sulphate of iron is poured into the peritoneum, and one of prussiate of potash into the pleura, five or six minutes usually elapse before the two combine, but that this happens instantaneously when a slight galvanic current is passed through the diaphragm. Absorption is also promoted by friction. Again, distention of the vessels retards absorption, while depletion accelerates it. Hence the use of venesection in dropsy. Absorption also takes place slowly in parts covered by dense membrane. Hence the absorbing power of the skin is much increased by removing the cuticle. Absorption takes place readily from the areolar tissue.

333. All these means of promoting absorption are used in the practice of medicine—*galvanism*, especially in the case of effusions into joints; *depletion* in dropsies of the skin and serous cavities; *abrasion* by blisters, followed by narcotic applications, in severe neuralgia; *friction* of the surface with nutritious fluids in cases of extreme emaciation, and with preparations containing mercury, iodide of potassium, etc., in the treatment of tumors and morbid growths; *subcutaneous injection* of narcotic solutions to relieve pain.

334. The absorption of fluids less dense than the blood is easily accounted for by endosmose, which takes place chiefly through the coats of the capillaries; and it is by this means, as just stated, that poisons find their way into the system. But the absorbent vessels also take up and restore to the circulation the serum which in the processes of nutrition has exuded through the parietes of the capillaries.

335. Of disordered functions of the absorbent vessels little is known. Formerly all dropsies were attributed to inaction of the absorbents, and such remedies were given as were thought to stimulate those vessels. It was obviously reasonable to suppose, that the functions of the absorbents, like those of other vessels, vary in activity at different times and under different circumstances; but as the capillaries have been proved to possess the power of absorption as well as the lymphatics, it is difficult to assign

to each class of vessels its proper sphere of activity, whether in health or disease. A special absorbent function of the lymphatics appears, however, to be indicated in certain cases, such, for example, as the swelling of the axillary glands in injuries to the fingers, or of the inguinal glands in primary syphilis—results which are attributed, and probably with justice, to the absorption of the poison by the lymphatic vessels.

336. But whatever the share taken in the work of absorption by the blood-vessels and absorbents respectively, there is no doubt that the part played by the absorbents in the production of dropsies has been much exaggerated. These arise in various states of system, and from various causes. Mechanical obstruction, venous congestion, inflammation, or debility, may give rise to an effusion of serum too abundant to be removed by the unaided, though still healthy, action of the absorbent vessels. If the obstruction be overcome, or venous congestion removed, or inflammation subdued, or the strength restored, the effusion ceases, and time alone is required to enable the absorbent vessels, whether capillaries or lymphatics, to take up the fluid which has been poured out.

337. The removal of solid diseased structures has also been attributed to the increased action of the absorbents, but perhaps without sufficient reason. Pressure, friction, and electricity, as well as mercury and iodine, are as likely to affect the small vessels which cause the morbid growth, as the lymphatics or capillaries which are instrumental in removing it—moderate pressure, by giving support to the vessels; stronger pressure, by still further diminishing their size; friction and electricity, by stimulating their coats and restoring their contractility; and iodine and mercury, by a local action on those vessels, whether through the skin, or more circuitously through the circulation.

338. In the case both of dropsies and tumors, the result would be the same, whether the small vessels, ceasing to exude fresh fluids or solids, the absorbents, without increase of activity, remove by degrees that which has been effused; or the vessels, continuing to exude, the absorbents are excited to a corresponding increase of activity. According to the first supposition the cause is removed; according to the second, the effect is counteracted. The first supposition seems the more correct.

339. An account of the circulation would be incomplete if no reference were made to the peculiarities of the circulation through the *liver* and *brain*.

340. The liver differs from the kidneys in being supplied for the purpose of secretion with venous instead of arterial blood. It is true that the solid constituents of the urine are also secreted from blood which has previously been submitted to the action of the Malpighian tufts; so that a circulation analogous to that of the portal system of the liver exists within the kidney. But in the liver (and this is true also of the lungs) the secretions are immediately derived from the venous blood conveyed to it by the vena portæ, which is formed by the union of the veins of the stomach and intestines, of the spleen, pancreas, and gall-bladder, of the mesentery and

omentum. With a slight and unimportant exception, it gathers the venous blood of the entire intestinal canal, and of all the organs engaged in the work of digestion, and conveys it to the liver, where the bile is secreted from it. The position of the liver, intermediate between the whole apparatus of digestion, on the one hand, and the right side of the heart and lungs on the other, explains its liability to congestion, from fulness of the portal system no less than from impeded circulation through the lungs.

341. The *brain* differs in its surroundings from every other organ. The viscera of the abdomen are contained in a yielding cavity with muscular walls; those of the chest in a cavity consisting partly of bone and partly of muscle, but allowing of considerable increase and decrease of size in all directions; but the brain is shut up in an unyielding bony cavity. All these cavities are air-tight; but that of the cranium alone is both air-tight and unyielding, at least in the adult. It follows, then, that while all the cavities of the body must always be full, the cranium alone must always contain the same amount of matter, for the atmospheric pressure of 15 pounds on every square inch of the surface of the body keeps the brain full, as it does a siphon. Now, the brain consists of a mass of nervous matter, supplied with blood by numerous vessels, and there is no reason to believe that this matter can suffer more compression than so much water; so that the strongest pressure which can be exerted upon it in the living body would probably not be rendered perceptible by the most delicate instrument. It is also an undoubted fact that the brain of a healthy man is not affected by a change in the pressure it ordinarily sustains. The descent in a diving-bell thirty-four feet below the surface of the water entails an extra pressure of 15 pounds on every square inch of the body, but the brain does not suffer. On the other hand, the ascent of a lofty mountain, or going up in a balloon, materially lessens the pressure on the body, and, consequently, on the cerebral vessels, and yet the brain is not affected. The inhabitants of some of the valleys among the Andes, who live as far above the sea as the summit of Mont Blanc, suffer only half the pressure the body has to bear at the sea level, and yet they enjoy health, bodily and mental. Again, the head of the infant suffers severe pressure during birth, and the yielding cranium of the child allows of large accumulations of fluid, and yet the brain suffers nothing during birth, and often very little in hydrocephalus.

342. Mere pressure, then, does not permanently affect the functions of the brain, and yet when blood, or serum, or lymph are found on its surface or in the ventricles, or a tumor in its substance, or a larger quantity of blood than usual in some of its vessels, death is said to have been caused by pressure. This statement is inexact. The blood encroaches on or displaces brain substance, but there is no alteration of pressure.

343. When blood is poured out suddenly, as in the common form of apoplexy, the symptoms are often more strongly marked though the

quantity of blood is very small, than in cases of slow effusion, or slow growth within the cranium, in which the brain adapts itself by degrees to the changes that are going on. If, in cases of apoplexy, the quantity of blood actually effused seems too small to account for the serious disturbance of the functions of the brain, we must take into account the injury the texture of the brain itself has suffered, as well as the disturbance in the balance of the circulation that must have preceded and accompanied the rupture of the vessels. That this disturbance is in itself sufficient to account for the symptoms is evident from reported instances in which all the symptoms of apoplexy have been present without a single morbid appearance after death, except a disproportionate quantity of blood in the veins and sinuses.

344. Though the bony walls of the skull are unyielding, and the brain incompressible, it is obvious that enlargement of the blood-vessels of the brain may result from diminution of the serum contained in the ventricles and the subarachnoid spaces; and that the intimate connection existing between the vessels of the brain and those of the scalp and face may become a source of relief and safety in sudden determinations of blood to the head. The flushed and turgid face of apoplexy, and the engorgement or rupture of the vessels of the scalp, in cases of death by hanging or strangulation, are familiar consequences of this vascular connection.

345. There are cases, then, in which the functions of the brain are greatly impeded, for which no other cause can be assigned but a want of balance in the cerebral circulation. The arteries contain scarcely any blood while the veins are full; and it must be obvious that the brain thus imperfectly supplied is incapable of performing its functions, and manifests symptoms of oppression.

346. When the venous blood is less decidedly in excess, the functions of the brain, of course, suffer less; and these slighter disturbances in the balance of the two circulations probably account for the conditions of the mind waking and sleeping. On the other hand, if the circulation through the arteries be increased, instead of torpor we have excitement characterized by heightened sensibility, strong muscular contractions, violent delirium, mania.

347. The balance of the circulation may be disturbed in various ways. Pressure on the jugulars or diseases of the lungs which obstruct the ingress of venous blood into the right side of the heart, followed by sleep more or less profound, by coma, or apoplexy, are examples of such disturbance originating in the venous system; while the sleep that follows pressure on the carotids is an instance of disturbance originating in the arterial system. An arrest of the heart's action, by putting a stop at once to the circulation through the brain, produces syncope, which differs from apoplexy merely in degree, the one arresting every function of the body, the other only oppressing them. A very feeble action of the heart will be attended with a like result; for the arteries receiving little blood, and the change from arterial to venous blood still going on, the brain will

contain but a small quantity of arterial blood, and must consequently perform its functions imperfectly. Hence the deep sleep, or coma, which often attends extreme debility, and the turgid condition of the veins of the head when death follows upon hemorrhage or other exhausting cause. In these cases, however, an effusion of serum generally accompanies the turgescence of the veins.

348. *Sleep* comes on, for the most part, at night, and in the recumbent posture. As a general rule, the pulse falls toward evening, and is also less frequent in the horizontal than in the erect posture. These two circumstances, then, which favor a slow circulation, also favor sleep, and partly explain its occurrence. But other causes must be taken into account, such as the darkness and silence, the absence of the usual impressions on the senses, and the exhaustion of the nervous system, this exhaustion reacting on the circulation, and the circulation, in its turn, reacting on the brain. Sleep, then, may be considered as due partly to exhaustion of the nervous system, partly to the absence of impressions on the organs of sense, and partly to the languid cerebral circulation. Intense cold, another familiar cause of sleep, probably acts partly by causing an accumulation of blood in the internal organs, and partly as a direct sedative. A languid cerebral circulation will result on either supposition. In the cold stage of ague, the same state of circulation exists, and the same condition of brain.

349. Among other causes of sleep may be mentioned repletion, and a certain stage of intoxication, the one leading to the circulation through the brain of the products of digestion not fully converted into blood; while spirituous liquors act as a stimulant in a small dose, and as a narcotic poison in a larger one.

350. The cerebral circulation varies much with the posture of the body. In the erect posture, the heart, in sending blood to the brain, has to oppose the force of gravity; but in the horizontal posture it has much less resistance to overcome. Hence, when the heart is feeble and the system drained of blood, a sudden change from the recumbent to the sitting or erect posture may cause fatal syncope; and, on the other hand, a patient who has fainted in the erect posture is soon restored by being laid on the back. When the head is lower than the rest of the body, the return of blood to the heart is opposed by gravity; the balance of the circulation is therefore destroyed, and coma is threatened. This unfavorable position, combined with sudden exertion, as in stooping to tie a shoe-string or pull on a boot, is an occasional cause of apoplexy.

351. The fact that the flow of blood to the head is favored by the recumbent posture, suggests the proper position in the treatment of diseases of the brain. When there is a high arterial action, the head should be raised; when great exhaustion, the body should be laid horizontally. Such changes of posture are often attended with the best effects: thus instances are recorded in which pain, intolerable in the horizontal posture, has been at once removed by assuming the erect position.

352. When, again, we wish to produce a sudden and strong effect on the system by bleeding, or to obtain the greatest effect with the least expenditure of blood, the patient is placed in the erect posture, for the heart soon loses the power of sending the blood upward to the brain, and fainting ensues.

353. Wakefulness, excitement, and delirium are the direct opposites of the states of drowsiness and sleep, and arise from an opposite state of the cerebral circulation. The degree of activity displayed bears a pretty exact relation to the rapidity and force of the arterial circulation, and to the strength of the patient. In the strong and robust, the outward manifestations in delirium are violent, and the muscles contract with great force ; but if the strength is much exhausted, the loud talking of furious delirium is exchanged for low muttering : the violent muscular efforts for subsultus tendinum ; and the distinct impressions on the senses for muscæ volitantes and tinnitus aurium.

3. STRUCTURAL PHYSIOLOGY AND PATHOLOGY.

354. In the two previous chapters the human body has been examined : first, as a chemical laboratory, in which the functions of digestion, assimilation, and sanguification are carried on ; and, secondly, as a hydraulic system, by which the blood is collected and distributed. It is next to be considered as an assemblege of minute structures, by which all its parts and organs are built up.

355. It has been already stated that the circulating system, consisting of arteries, capillaries, and veins, forms a continuous and unbroken, though most minutely divided, reservoir of blood in motion. The arteries serve as carriers of pure blood *to* the several tissues, the veins as carriers of impure blood *from* them, while the capillaries, the immediate agents of growth and nutrition, connect the two classes of vessels.

356. As the capillaries have no open mouths, the tissues can be nourished only by transudation through their walls. The fluid employed in this work of nutrition is the *liquor sanguinis ;* in other words, the blood itself less its red particles. As this fluid contains albumen and fibrin, and all elementary substances necessary to nutrition, it is obviously equal to the use thus assigned to it. At times, many of the capillaries transmit only this colorless liquid.

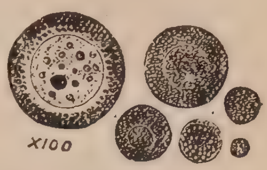
357. The liquor sanguinis exuding through the coats of the capillaries, and brought into contact with the tissues, subserves the purposes of nutrition and growth, by being converted into cells (Schleiden and Schwann), or "germinal matter," and "formed material" (Beale).

358. According to the first-named authorities, all the tissues of the body are made up of cells, which consist originally of three distinct parts : the cell membrane, the nucleus, and the nucleolus. The cells are developed in a semifluid molecular substance derived from the blood, termed *blastema* (Fig. 8[1]).

[1] Mammalian ovum in its several stages of growth.

359. Cells, which in their free state have the rounded form of Fig. 8, assume the hexagonal form from mutual pressure in a solid tissue, as in the more compact forms of the adipose tissue. In some structures, such as cartilage and tendon, there is an abundant intercellular substance or matrix, in which separate cells or small clusters of cells are imbedded. Cells are readily converted into fibres (Fig. 10, *b*) by elongation and into tubes by arrangement into lines and absorption of the opposed extremities. In the former case a fibrous tissue results, in the latter an organ such as a capillary, absorbent, or nerve fibre.

Fig. 8.



360. Cells readily multiply by splitting and budding, processes which may affect the whole cell, or only the nucleus. The latter may divide into many parts, the cell contents increasing and the cell membrane enlarging *pari passu.* Each portion of the divided nucleus grows, attracts to itself its due portion of the cell contents, the outer surface of which condenses into a membrane. The new cells thus formed may be set free by rupture of the membrane of the parent cell.

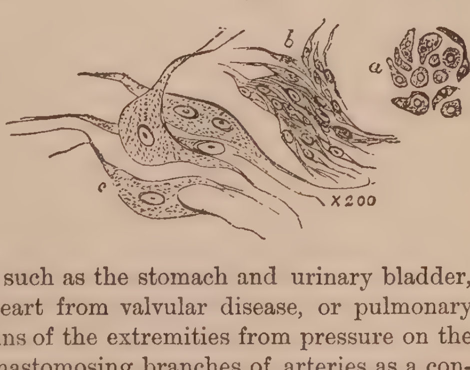
361. Cells also enter into the composition of some of the fluids both in health and disease. The white particles which float in the liquor sanguinis of the blood are nucleated cells; so also are the lymph globules; and the mucous and purulent secretions, thrown out from inflamed surfaces, contain mucus and pus-globules.

Fig. 9.

362. Suppuration consists in the growth of pus-corpuscles (Fig. 9), from the plastic exudation (blastema) which is thrown out in the process of repair; while the more internal portion is developed into blood-vessels and connective tissue.

The development of cells is well illustrated in the formation of malignant tumors, which as a rule are entirely made up of cells; and it is in these perverted growths that the greatest activity of cell production is witnessed. Fig. 10, *a*, represents the *round-celled sarcoma* from a cervical gland; *b*, the *spindle-celled sarcoma* from a case of cancer of the uterus; *c*, the *large-celled spindle-celled sarcoma* from a recurrent tumor of the scapula.

Fig. 10.



363. Structural changes may consist in a simple enlargement of parts and organs, such as the stomach and urinary bladder, from habitual distention; the heart from valvular disease, or pulmonary or systemic obstruction; the veins of the extremities from pressure on the large venous trunks; and the anastomosing branches of arteries as a consequence of the ligature of the main trunk. This is called *Hypertrophy.*

364. A second class of structural changes consists in defective *nutrition,*

leading to a diminution in the volume or weight of the particular structure affected. This constitutes *Atrophy.*

365. The principal cause of *hypertrophy* is increased action; of which illustrations are afforded by the muscles of the athlete, by the heart and bladder when they encounter an obstacle to the evacuation of their contents, by the uterus during pregnancy, by the mammæ during lactation, by the mucous membrane of the bladder exposed to irritation from stone or gravel, and by the small arteries in organic disease of the viscera which they supply.

366. *Atrophy* arises from opposite causes; from disuse of parts, as of the muscles in the sedentary, paralytic, and bed-ridden, from obstruction to the flow of blood by ligatures, or from the operation of such powerful medicines as iodine and the salts of lead. Internal organs may also become atrophied from a cause described in § 372. Atrophy is marked by paleness of the parts affected, as hypertrophy is by increase of color.

367. Hypertrophy and atrophy are sometimes limited to one constituent part of a texture. Thus bone may become unusually hard from the crowding of many earthy particles into the space commonly occupied by a few, or soft, from absence of the earthy matter.

368. A third class of structural changes consists of the effects of common inflammation (§ 276, *et seq.*).

369. A fourth class comprises the effects of inflammation due to specific causes—to poisons introduced into the body from without by insertion or *inoculation,* by application to the skin, by inhalation through the lungs, or by admixture with food or drink. The local effects, direct and transferred, produced by wounds received in dissection, by syphilis, by mercury, arsenic, lead, copper, and phosphorus used in the arts, by the contagion of plague, typhus fever, and the exanthemata, and by drinking water or milk polluted by sewage, afford examples in point.

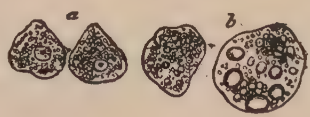
370. A fifth class consists of those which are brought about by causes acting within the body itself, originating in the blood-vessels, and producing structural changes either by simple mechanical impediment or by a taint imparted to the blood. To the first class belong the fibrinous clots formed in arteries or veins, or in the heart itself, which may either continue in the spot where they were formed, or be transferred by the current of the circulation to some smaller vessel often very remote from the origin of the mischief, there to give rise to obstructed circulation and consequent structural change. To the second class belong those local abscesses in the liver, lungs, serous cavities, and joints which spring up as a consequence of the blood becoming the carrier of purulent matter formed in some venous trunk, or in the open mouths of veins wounded or otherwise exposed. The mechanical impediments of the first class are now familiarly known by the names of *thrombus* and *embolus;* the purulent deposits of the second class as *secondary abscesses.*

371. *Fatty Degeneration.*—All the tissues of the body, as well as the morbid growths which are developed among them, are liable to a fatty metamorphosis. The deposit of fat or oil-globules in the secreting cells

of the liver and kidney constitutes the condition known as fatty degeneration of the liver, and certain forms of Bright's disease of the kidney. The oil-globules are deposited in the epithelial cells of the secreting surfaces, and in the cellular tissue connecting the vessels. The annexed illustrations show the mode in which oil-globules are deposited in the cells of these organs. In Fig. 11, *a* represents healthy cells of the liver, free

Fig. 11.

Fig. 12.

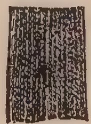


from oil-globules; and *b*, cells from a liver in a state of fatty degeneration. In Fig. 12, *a* represents healthy epithelial cells of the kidney; and *b*, cells loaded with oil-globules. In disease of the kidney, the secreting tubes lined with cells containing oil-globules are expelled with the urine, so as to furnish evidence of the true character of the disease.

372. The first effect of these abnormal deposits is to increase the size of the diseased organs without materially affecting their functions; but as the disease advances the fatty deposits encroach more and more on the vessels and gland structure, so as on the one hand to restrict the supply of blood, on the other to impair the secreting power of the cells. Hence, in extreme cases, the organs affected are rendered *anœmic*, and become quite unequal to their functions; and instead of increasing in size, they lose bulk from failure of nutrition and the absorption of the oil-globules, which were the first result of the disease.

373. But deposits of oil or fat are not limited to the secreting organs: they take place also in the tissues. They are laid down, for instance, in the muscular structure of the heart, and enfeeble it by encroaching on and displacing the healthy muscular tissue. (See Fig. 13.)

Fig. 13.



374. Associated with earthy matter, as *atheromatous* deposits, fat often occurs in the coats of arteries, in subjects affected by similar disease of the liver and kidneys. These deposits are situate either in the inner coat, or in the fibres of the middle coat itself. Fig. 14, *a*, *a* are corpuscles of connective tissue developed in the middle coat, and converted into fatty sphericles. This change leads to impairment of elasticity, and consequent dilatation of the artery. When the coronary arteries are thus affected, the muscular substance of the heart becomes atrophied. These deposits are found to obey the law of symmetry, attacking equally and similarly the vessels on both sides of the body.

Fig. 14.

375. Atheromatous deposits in the coats of arteries often become the seat of ulceration, leading to perforation and sudden death from hemorrhage. When the ulcers make their way through the inner coat of the arteries, they project from it as ragged, uneven tumors, and when they occur in the aorta, are frequent causes of abnormal blowing and sawing sounds. In other cases the atheromatous spot becomes the nidus of calcareous deposit, in which case the vessel is said to degenerate into bone.

376. The small vessels of the brain are also subject to fatty degeneration. Oil-globules are deposited in the transverse muscular coat of the arteries, and in the corresponding coat of the veins. They may be seen under the microscope, either as "minute, shining, black-edged particles, like molecules of oil, thinly and irregularly scattered beneath the outer surface of the small blood-vessels;" as globules of larger size more closely packed together; or in round or oval clusters, "like large granule-cells." The engraving (Fig. 15), from a paper by Sir James Paget, in the *London Medical Gazette,* 1850, shows the microscopic appearance of small arteries under this form of degeneration.

Fig. 15.

377. This deposit of oil-globules destroys the even outline of the vessels, and, their proper structures gradually wasting, the smaller vessels dilate into minute aneurismal pouches. The proper vascular structure being thus weakened, softening of the brain ensues, followed by rupture of the vessels. This is one cause of apoplexy.

378. In certain conditions of the blood fibrinous deposits form on the inner surface of the arteries. Their most common seats are the valves of the heart and aorta, the larger vessels at the points where they give off branches, and the smaller arteries throughout their whole extent. They undergo induration and are often converted into gristly or bony tissue. Calcareous deposits, having the hardness of bone, are also of frequent occurrence in the heart and arteries as independent formations; that is to say, they take place where the structures have not previously undergone any other form of degeneration.

379. Recent researches have attached a new and unexpected interest to these valve-deposits. They occasionally become detached from the mitral valve, and, being borne forward by the current of the circulation, lodge in an artery of the brain, impede or stop the circulation through it, cut off the supply of blood to a part of the brain, which becomes softened, and so give rise to hemiplegia. This formidable accident is now grown familiar to us under the name of *embolism.*

380. Another instance of fatty degeneration has been pointed out by Mr. Canton in the *arcus senilis,* or white line, seen just within the circumference of the cornea in many aged persons, in some who have passed the middle of life, and occasionally as early as 35 years of age. It is sometimes associated with fatty degeneration of more important organs. Fatty de-

generation of the ovum has also been shown to be a frequent cause of abortion.

381. It will be seen, then, that deposits of oil-globules, or fat, whether in the cellular membrane uniting the vessels of secreting organs and in the coats of arteries, or in the epithelial cells of secreting membranes; whether continuing in their original form, and encroaching gradually on the healthy structure of the organs they attack, or becoming the seats of ulceration, or of calcareous deposit—play a most important part in the history of organic disease.

382. These fatty deposits may sometimes be confidently traced to imperfect oxygenation of the venous blood. Fatty degeneration of the kidney, for instance, is a common occurrence both in men and animals living in dark, filthy, and ill-ventilated places, where the air is unfit to support the process of combustion in all its vigor, at the same time that the constitution is enfeebled. Again, fatty degeneration of the liver and kidneys, atheromatous deposits in the arteries, and fatty degeneration of the heart, are often found associated in the spirit-drinker, who constantly introduces into his system a large supply of a liquid hydrocarbon, of which the gaseous elements attract the oxygen that ought to be devoted to the combustion of the carbonaceous matters derived from the food, and from the effete textures of the frame.

383. French epicures, by producing fatty livers in geese, through a combination of high feeding and heat, have given us another lesson as to the causes of this diseased condition—causes which find their combined application in the production of liver disease in Europeans who carry the dietetic customs of England to the hot climate of India.

384. Morbid growths generally may be divided into two classes—*non-malignant* and *malignant*. The first comprises *tubercle*, the second the several forms of *cancer*. Tubercular diseases generally fall under the care of the physician: malignant diseases more commonly into the hands of the surgeon. But both classes may attack either the internal or external organs of the body.

385. *Non-malignant Diseases.—Tubercle.*—This is deposited on the surface of membranes, or in the texture of organs. It has two different forms—the one, whitish gray, semi-transparent, and dense; the other, yellow, opaque, and friable. The first is an earlier stage of the second. The gray tubercle is scattered through the lungs as miliary tubercles, or on the surface of serous membranes. The other variety is found in the same situations, as well as on the surface of the mucous membranes and in the substance of organs—in the follicles of the intestines, in lymphatic glands, in the liver, spleen, brain, uterus, etc. It assumes different forms in different situations. It may be collected in a distinct mass, or diffused through the tissues of an organ as a homogeneous cheesy matter; or it may be so thoroughly blended with the textures as to assume the very form of the organ attacked.

386. Tubercle consists of albumen, fibrin, gelatin, salts of soda and

lime, and water, with a little fatty matter. Under the microscope *miliary* tubercle presents the appearance of molecular matter, and granules blended with nucleated cells, indistinguishable from plastic exudation. The yellow variety also consists chiefly of granules, interspersed with minute spherules, irregular flakes, numerous oil-globules, and a few perfect cells.

387. Tubercle is rarely deposited before birth; it is not common before the fourth year; is frequent between the fourth and fifth; less frequent, again, from this time till puberty; most frequent of all between puberty and the age of fifty. The lungs are its most common seat, so that after fifteen it is almost never met with in other organs without existing in them at the same time. The state of constitution (*tuberculous cachexy*) which leads to tubercular deposit may be either inherited or acquired.

388. Tuberculous matter is deposited slowly, without causing pain or inconvenience, and may remain quiescent for a very considerable period. At length, in the course of a common cold, or slight febrile attack, the tubercle begins to act as a foreign body, and sets up inflammation in the surrounding tissues. When this change takes place in the absorbent glands, serum and pus are poured out, and an abscess is formed, which slowly approaches the surface, bursts, and discharges the tubercle softened and broken down by the effused fluids. The walls of the abscess then generally contract and heal. Tubercles in the lung undergo the same change, the matter being expectorated; but sometimes they are converted into a chalky or earthy matter, and remain quiescent for the rest of life. When the deposit is in the mucous membrane of the larynx or intestines, the membrane ulcerates.

389. Scrofulous subjects are not only liable to tubercular deposits but also to the chronic forms of inflammation, suppuration, and ulceration. The lymph effused, as the result of inflammatory action, is curdy, and wanting in consistence, the pus serous and flaky, and granulations, when formed, are large, pale, and flabby. Pustular, scabby eruptions of the ears and mouth, discharging a thin acrid matter, enlargement, inflammation, and suppuration of the absorbent glands, especially of the neck, and a similar affection of the mesenteric glands, are also common in scrofulous children.

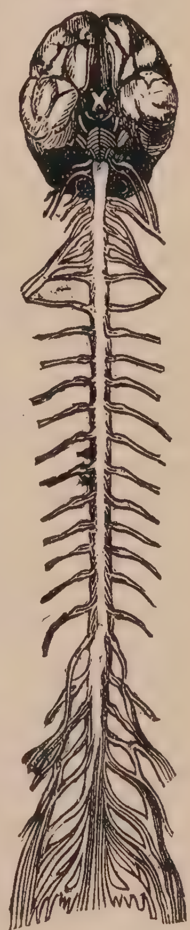
390. It has been shown experimentally that tubercular deposits may be produced at will in animals by confining them in close dirty places, and feeding them on unwholesome food.

391. *Malignant Diseases.*—These formations resemble tubercle in affecting almost all the organs of the body; in being frequently traceable to hereditary predisposition; and in their tendency to excite destructive inflammation of the parts attacked. On the other hand, malignant growths are distinguished by extending into surrounding textures, stirring up inflammation in them, and progressively destroying them; by following the course of the absorbents and attacking the lymphatic glands; and by reappearing, after removal, in or near the cicatrix, or in some internal organ nearly connected by the absorbent system with the part first attacked.

Malignant growths may be all comprised under the general name of Carcinoma or Cancer.

392. *Carcinoma* (*Cancer*).—This term was originally applied to a malignant ulcer supposed to bear a resemblance to a crab (καρκίνος, cancer). It now comprises many changes of structure, differing widely in their physical characters: as scirrhus, or hard cancer; medullary, or soft cancer (with its most vascular form, fungus hæmatodes); epithelial cancer; melanotic cancer (characterized by the presence of pigment); osteoid cancer; and colloid cancer, characterized by the transparent or gelatinous substance of which it consists.

Fig. 16.



393. *Melanosis.*—This is an unorganized product, of a dark brown, dull bistre, or sooty-black color, deposited in masses with or without cysts, or in patches on membranous surfaces. Sometimes it is met with in small points and occasionally it has been found liquid. Its most frequent seat is the liver; but it is sometimes found in the eye, skin, brain, lungs, kidneys, and other glandular organs. Its chemical constituents are albumen, fibrin, and the salts usually found in the blood, with a coloring matter abounding in carbon. When associated with malignant growths, the cells, instead of continuing free, are attached to the surrounding tissue. Deposits of a black pigment are often found in the bronchial glands and on the surface of the lungs both before and after birth. Such deposits are not malignant.

4. THE NERVOUS SYSTEM.

394. It is not possible to represent in a single diagram (such as that which, at p. 53, is used to illustrate the mechanism of the circulation) that complex arrangement of nerve-masses and nerve-fibres, known as the nervous system. The brain and spinal cord, shown in plan in Fig. 16, and the brain, shown in vertical section in Fig. 17, are but the conspicuous parts of a whole which requires the sympathetic nerve for its completion, and of which the delicate terminations are to be found, accompanying the smallest vessels, in every organ and texture of the body.

395. The *brain*, of which the base, with the nine pairs of nerves arising from it, is shown in Fig. 16, and the vertical section, displaying the three leading divisions (cerebrum, cerebellum, and medulla oblongata), in Fig. 17, is the centre to which all sensations are referred, and from which all voluntary efforts originate. The *spinal cord*, with thirty-one pairs of nerves springing from it, for distribution to the trunk and limbs, may be said to

occupy an intermediate position between these nerves and the brain; while the brain and spinal cord together form the joint source from which all the nerves of sense and of voluntary motion arise, from which all the mandates of the will are sent forth, and to which the intelligence of every sense is conveyed. From these centres, too, the nerves which control the movements of respiration and circulation take their rise. The *sympathetic* nerve, connecting itself with the several nerves of sensation and volition which spring from the brain and cord, presides over the functions of many of the organs most essential to life, is the source of some of those movements which are independent of the will, of many of those sensations by which life is preserved, and of the chemical changes peculiar to living beings. The spinal marrow, again, is the centre of union of certain nerves which form with it the excito-motory system, the seat of the reflex function. One set of nerves passing from the skin and mucous membranes convey to the cord certain impressions which, not passing onward to the cerebrum, are not perceived; while another set, arising from the cord, and being distributed to the muscles, give rise to contractions which, as the impulse does not originate in the brain, are involuntary. This excito-motory system and reflex function bear a very important part in all those movements which subserve the most pressing wants of the frame, such as the ingestion of food and the supply of air in breathing. Lastly, the *cerebellum* has been shown to be the centre and source of a co-ordinating function, or harmonizing control, exercised over those voluntary muscles which have come to act in unison for the production of certain complex movements, such as those of standing, walking, working with the arms and fingers, speaking, and singing.

Fig. 17.

396. The following scheme, then, represents the leading functions of the nervous system, as well as the portions of the nervous centres by which they are performed:

(1) Sensation and voluntary motion, of which the brain is the centre.

(2) Co-ordination of voluntary movements, of which the cerebellum is the centre.

(3) The excito-motory, or reflex, of which the spinal cord is the centre.

(4) The vaso-motor, of which the sympathetic or ganglionic system forms the principal portion.

397. (1.) The first order comprises all the nerves of *sensation* (the olfactory, the optic, the auditory, the gustatory, and the nerves of touch), and all the nerves of voluntary motion, with their common centre in the cerebrum. The greater part of the nerves of touch, or common sensation,

and the nerves of voluntary motion form the external portions of the spinal marrow, and through it communicate with the brain.

398. (2.) Of the second order it must suffice to state that pathology and experiment combine to prove that the cerebellum, with the posterior columns of the spinal cord, which are downward prolongations of it, is the centre of a co-ordinating function voluntarily exercised over the motor nerves. The reason for associating the posterior columns of the cord with the cerebellum as the seat of this function are: that they are not sentient, that motion is not destroyed when they are divided, but that by such division muscular movements are thrown into disorder.

399. (3.) The third order consists of two sets of nerves, of which the one passes chiefly from the mucous surfaces to the interior parts of the medulla oblongata and spinal cord, and the other from those parts of the medulla and cord to muscles which are chiefly subservient to ingestion and egestion. Some fibres of the same order of nerves are probably distributed to the skin and voluntary muscles. That part of the spinal marrow to which these nerves run has been called the *true* spinal marrow, in contradistinction to those parts of it which are formed by longitudinal (commissural) fibres going to the brain. The motions due to this system are said to be *excited*, and the nerves are distinguished as *afferent* and *efferent*, *incident* and *reflex*. Through these nerves the mouth of the infant, when applied for the first time to the mother's breast, performs the movements of suction—movements which take place even in the acephalous infant; through them, too, the contents of the bladder and rectum are expelled; and foreign bodies discharged from the air-passages by sneezing and coughing.

400. The fourth order of nerves, or the ganglionic, consists, *a*, of the *internal* ganglionic, or sympathetic; and, *b*, the *external* ganglionic, embracing the ganglia on the roots of the fifth and eighth pairs of cranial nerves, and those on the posterior roots of the spinal nerves. These latter are supposed to preside over secretion and the nutrition of the external organs, and hence are called *trophic* or *excito-secretory* nerves. The former, the sympathetic proper, presides over the movements of the involuntary muscular fibre (of the heart, blood-vessels, intestines, etc.), and is therefore called *vaso-motor*. This regulative action, as it affects the blood-vessels of the glands, results in an increased or diminished amount of secretion; and hence this system of nerves may be assumed to possess an "*excito-secretory*" function, so called.

401. The leading functions of the nervous system, then, are: 1, sensation and voluntary motion; 2, co-ordination of muscular movements; 3, excitements to action without sensation, and combined motions without volition; and, 4, nutrition, secretion, and the motions connected with them. To these must be added the mental functions, which have their seat and organ in the cerebrum, and which will have to be considered in the next section.

402. The nerves consist of bundles of minute fibres, enclosed in

sheaths. Each fibre is distinct through its entire course, and connected at its origin with a nerve vesicle. It remains unbroken till it arrives at the part to which it is distributed, when it begins to branch freely, and, uniting with similar branches of other nerves, forms at last a network of excessive tenuity, associated in some cases with special "end-organs."

403. Experiment has revealed to us the functions of the more important nerves, but has left much yet to be discovered. It has also thrown light on the laws that govern the transmission of nervous force, though it has left the nature of that force involved in the same obscurity which hangs over the real essence of light, heat, or electricity, with which last, however, it appears to have many points in common.

404. The effect of the division of a nerve is well known. If it be one of sensation, irritation of its branches or trunk below the point of division causes no pain; if it be one of voluntary motion, neither the will nor a stimulus applied to it above the point of division can cause the muscle to which it is distributed to contract. On the other hand, if the voluntary nerve be irritated below the point of division, or the sentient nerve above it, motion takes place in the one case, and sensation in the other; the sensation being referred to the parts to which the nerve is distributed. This law of sensation is strikingly illustrated in cases of amputation of a limb. Irritation of the cut end of the nerve is referred to the fingers or toes of the lost limb for years after its removal.

405. The fact that irritation of the trunk of a sentient nerve causes pain, not in the trunk itself, but in the parts to which its branches are distributed, admits of practical application, and tends to destroy confidence in the division of nerves as a remedy for pains in the parts they supply. But the failure of this remedy in some cases has been explained by the discovery of some permanent cause of irritation, such as a tumor or spicula of bone, at the origin of the nerve.

406. Pressure applied to a sentient nerve causes pain in the parts supplied by its branches, but a firmer pressure produces pain in the trunk of the nerve itself. Severe injury to a nerve of sensation or voluntary motion destroys its power as a conductor of nervous force, but it affects the nerve itself only locally; for irritation of the part of the uninjured sensitive nerve connected with the brain causes sensation, and irritation of the part of the nerve of volition connected with the muscles excites muscular contraction. When, however, a nerve of motion is stretched violently through its whole length, it can no longer conduct the stimulus of muscular contraction, and sometimes the muscle itself loses its irritability, and cannot be made to contract by the most powerful stimulus.

407. Experiments on animals have brought to light other properties of the nerves which may be advantageously borne in mind by the pathologist. It has been proved that all stimulants applied to the nerves of the dead body act nearly in the same way, though with different intensity; but electricity and galvanism are the most effectual. The muscles cannot be made to contract by any degree of mechanical irritation applied to a nerve

of sensation, while the slightest irritation of a nerve of motion gives rise to very strong contractions. Hence it appears that the motor nerves themselves can excite muscular contractions on the application of stimuli, independent of the brain and spinal cord. It has been further shown that this property may be exhausted by the continued application of a stimulus, to return after an interval of rest.

408. These experiments on dead animals are in accordance with the results of observation in the living human body. The exhausted nervous power must be restored by rest; the exhaustion of the entire frame repaired by sleep; and stimuli, whether mechanical, chemical, or electrical, cause the nerves to which they are applied to manifest their characteristic properties. Irritation of a nerve of common sensation causes pain; of a nerve of motion, muscular contraction; and the stimulus of galvanism excites in each organ of sense the sensation proper to it—taste in the tongue, a peculiar odor in the nose, light in the eye, a musical sound in the ear. Lastly, irritation of the origin of the pneumo-gastric nerve gives rise to a derangement of the digestive process manifested by the elimination of sugar by the kidney.

409. Heat, cold, and electricity are used as remedial stimulants. Both heat and cold cause the muscles to contract, and, when excessive, destroy their irritability. Cold water injected into an artery causes contraction in the muscles which it supplies; hence in uterine hemorrhage following delivery, cold water is injected with effect into the vessels of the still adhering placenta, and cold suddenly applied externally or internally causes contraction of the uterus. The good effect of electricity and galvanism is manifested in some cases of paralysis.

410. Stimuli of great intensity destroy the excitability of the nerves, as happens with the optic nerve when a flash of lightning produces permanent blindness; and with the brain and spinal cord when it causes sudden death. Permanent paralysis may arise from the same cause. A weaker stimulus applied for a longer time may produce the same effect. Thus, snow-blindness sometimes follows the continued strong reflection of light on the retina, and paralysis of the muscles violent and long-continued exercise. Weaker stimuli, or the same stimuli applied for a shorter period, impair the excitablity of the nerves and cause fatigue. Thus, the eye fixed for a long time on the same color becomes insensible to it; and if the same set of muscles is kept in action only for a few minutes, as when we hold an arm extended, or stand quite still, we feel extreme fatigue, from which the slightest change of posture affords instantaneous relief.

411. Nervous exhaustion is always accompanied by severe pain. Thus, the long-continued application of the stimulus of light to the eye, or of cold or heat to the skin, gives rise to acute suffering; and prolonged action of the muscles in walking may occasion the most excruciating agony.

412. A stimulus, then, applied to the nerves of sensation or voluntary motion, produces, according to its degree and duration, destruction or ex-

haustion of the nervous power, accompanied in extreme cases by severe suffering; and the functions of the nerves are not restored till after rest proportioned to the exhaustion. The brain and spinal cord are the sources of the restorative influence; and motor nerves, permanently cut off from those centres, no longer excite muscular contraction.

413. Stimuli, therefore, first excite the nerves, and then exhaust them. But there are substances known as *narcotics* which have the effect of deadening the excitability of the nerves, and, in a concentrated form, of destroying it. If, for instance, the sciatic nerve of a frog be dissected, and allowed to hang in a solution of opium or morphia, the nerve is deprived of its power of exciting muscular contraction, and the leg of a frog steeped in a solution of opium or of hydrocyanic acid, is similarly affected. The same effect is produced upon the heart by infusions of opium and tobacco; on the intestines by opium and ticunas; on the circular fibres of the iris by belladonna; on the hands by lead; on the lips and tongue by chewing monkshood; and on the fingers by the vapors of strong hydrocyanic acid.

414. Narcotic poisons introduced directly into the circulation, or indirectly through the stomach or other circuitous channel, also act locally on the nerves. Thus, Müller, having divided all the vessels and muscles of the thigh of a frog, poisoned the animal with nux vomica, and found that the irritability of the sound leg was lost much sooner than that of the mutilated one. This loss of irritability in the sound leg can only be explained by the circulation through it of blood containing the poison, and the consequent local effect of the poison on its nerves; and it is by such local effect on the nerves most essential to life, or on the nerves supplying the heart or lungs, that narcotic poisons, after being absorbed and circulated with the blood, prove fatal.

415. Poisons introduced into the circulation act with greater force than when applied directly to the nervous trunks. Thus, strychnia applied in powder to the moist spinal cord of the frog excites no twitchings of the muscles, while the most violent contractions are produced by very small quantities absorbed into the blood. Other experiments may be adduced to prove that poisons circulating with the blood produce their effect chiefly by acting on the spinal cord and brain. Thus, when an animal is poisoned by strychnia, if the nerves of one limb are divided, the spasms of that limb cease: and if the spinal marrow is cut through before an animal is poisoned with upas, the parts supplied by nerves from the lower portion of the cord are not convulsed. Narcotic poisons generated within the body itself also act on the nervous centres through the circulation. Thus, urea, when it accumulates in the blood from loss of power in the kidneys to eliminate it, acts on the brain, and causes fatal coma.

416. The foregoing observations apply chiefly to the nerves of sensation and voluntary motion, which have the brain and certain portions of the spinal cord for their origin and centre. The sympathetic nerve and the excito-motory system yet remain to be examined.

417. *The Sympathetic.*—The functions of this nerve are threefold: it presides over the involuntary muscular fibre; it is the medium by which all impressions are conveyed from the parts to which it is distributed to the nervous centres; and it regulates the processes of secretion and nutrition in every part of the frame.

418. With regard to the first of these functions—that of directing the involuntary motions of the more important viscera—it has been ascertained that the parts which this nerve supplies continue to move long after they are separated from the rest of the sympathetic system, and even after their removal from the body, whether the motions are rhythmic, as in the heart, or continuous, as in the intestines: and that the contractility of these parts survives that of the voluntary muscles. The effects of stimuli applied to the sympathetic nerve are also more permanent than those of stimuli applied to the nerves of voluntary motion.

419. All the parts supplied by the sympathetic nerve are, to a certain extent, independent of the brain and spinal cord. Thus, the heart will continue to beat long after the division of its nerves, after severe injury of the brain and spinal cord, and even after its entire removal from the body. That the spinal cord, however, does influence the contractions of the heart has been proved experimentally; and that the brain acts upon them is shown by the familiar effect of mental emotions. Certain excitations of the brain and spinal cord are doubtless conveyed to the sympathetic by means of the *rami intercommunicantes* existing between the two systems of nerves, and by the same channels impressions on the sympathetic may be conveyed to the spinal cord and brain, and excite either sensation or movement in parts to which the cerebro-spinal nerves are distributed.

420. The impressions made on the fibres of the sympathetic are not usually conveyed to the brain; in other words, they are not of the nature of sensations; but violent irritation may give rise to sensation in parts supplied by nerves from the sympathetic as well as in those supplied by cerebro-spinal nerves. When these last-named nerves are the seat of the irritation, the painful sensations are usually experienced in the extreme parts of the organs which they supply: thus, we have itching of the nose and anus from worms in the intestines, and pain and itching in the glans penis from disease of the kidneys and bladder. But irritation in the intestines, or a disordered condition of the uterine functions, is a familiar cause of reflected sensations of a still more marked character, such as acute pains in the muscles of the chest and abdomen in hysterical females, accompanied by tenderness of the spine itself, and sometimes removed by remedies applied to that part.

421. The same irritation conveyed to the spinal marrow, and accompanied by tenderness there, may also be reflected through the motor nerves, and give rise to spasmodic seizures. Thus, intestinal irritation occasions convulsions, chorea, and tetanus in infants and young children, and hysteria affecting the muscles of voluntary motion, but especially

those of respiration, in adults. Vomiting and hiccough are also produced by irritation of the nerves of the intestines, kidneys, or uterus.

422. The sympathetic nerve has been shown to preside over secretion and nutrition, and consequently over the functions of the parts concerned in these processes: the minute vessels, therefore, and the arterial system generally, fall under its influence. Section of the sympathetic on one side of the neck causes permanent dilatation of the capillaries of the corresponding side of the face, and on irritating the trunk of the nerve they again contract. But although the organs of circulation are thus placed directly under the influence of the sympathetic, the occurrence of syncope and blushing through mental emotion proves that impressions on a sentient nerve may be reflected on the parts which it supplies. These reciprocal phenomena are due to the interchange of fibres between the two systems of nerves. The alteration in the size of the capillaries under the influence of emotion and in inflammation has been already adverted to (§ 271 *et seq.*).

423. Such being the functions of the sympathetic, it follows that the circulation, both general and local, must be closely dependent upon the condition of this nerve. It is probable that the various states of circulation indicated by a pulse, ranging between a sharp, hard, and excited beat on the one hand, and a full, weak, compressible one on the other, are due to variations in nervous force transmitted by the sympathetic to the muscular tissue of the heart and arteries. It is also probable that the dilatation of the small vessels in inflammation is due to diminished nervous power in the sympathetic.

424. In the general, as in the local affection, we may have first the application of a stimulus, accompanied by increase of nervous force and consequent contraction of vessels, and then, as a necessary consequence, diminished nervous force, and a relaxation of vessels. This contraction of the vessels is not overcome by a reaction in the centre of the circulating system, but yields to that diminished contractility which follows as certainly upon increased action as blunted sensibility upon over-exertion of the organs of sense, and fatigue upon long-continued or violent action of the muscles.

425. The sympathetic nerve, as the name implies, is assumed to be the organ of many of those combined sensations, motions, and secretions which we call *sympathies*, by which we mean the reflection of impressions from one part of the nervous system to another and different part. It may be otherwise defined as reciprocal feeling or action between different nerves, and therefore between different parts, caused by reflex nervous action. The nerves of the surface and the central organs of the nervous system, for instance, react on each other; the affection of the central organs in fever causing the various conditions of the skin, and shocks to the skin exciting the brain and spinal cord. Again, cold water poured on the head restores the brain exhausted by long-continued inflammation; and dashed in the face or thrown on the chest, removes an hysterical or faint-

ing fit, excites the nervous centres in cases of narcotic poisoning, and is the most efficacious of remedies in asphyxia.

426. Sensitive nerves sympathize with sensitive, motor with motor, and sensitive and motor with each other. The optic, the olfactory, the auditory, and the ciliary nerves of the two sides are affected at the same time and in the same way, and an affection of one side often leads to a similar affection of the other: inflammation of one eye to inflammation of the other. This sympathy between nerves of sensation supplying double organs extends also to nerves of different kinds and functions: thus, a strong light on the eye produces tickling in the nose; tickling the feet throws the whole body into convulsions; certain sounds put the teeth on edge; a tumor on a nerve may cause pain or spasms in parts of the body not directly connected with it. To such phenomena the term *radiation of sensations* has been applied. Sympathies of motor nerves with each other occur in all associated movements; those of motor with sensitive nerves belong to the class of excited or reflected motions.

427. The sympathies of entire organs with each other are very important. They may be classed as follows: 1. Sympathies between organs having similar structure and function: as the different salivary glands, the heart and blood-vessels, the stomach and intestines. 2. Sympathies between organs belonging to the same system: as the digestive, the urinary, the generative, the respiratory system, and the united respiratory and circulating system, the lungs and heart. Thus, vomiting attends the passage of a gall-stone into the intestines. 3. Sympathies of important viscera with the central organs of the nervous system: as in the convulsions from teething, or intestinal irritation; the sick headache, caused by the presence of indigestible food in the stomach; and, conversely, the disorders of the stomach resulting from irritation or concussion of the brain. Epileptic fits often have their source in irritation of the stomach, uterus, etc. 4. Sympathies between organs not connected in any of the foregoing ways: such as the parotid gland with the testicle; the mamma with the uterus; the larynx, and the glands which secrete the hair, with the organs of generation. To this class, too, belong the sickness attending the passage of a renal calculus into the bladder, the rigors that sometimes follow the use of the catheter, or the pain of acute orchitis.

428. The *excito-motory system.* The following plan will exhibit the extent and importance of this system:

Incident branches.	*Reflex motor branches.*	*Excited actions.*
I. Trifacial, arising from:		
a. The eyelashes. *b.* The alæ nasi.	The trochlearis } oculi. The abducens }	Protective movements of the eyes and eyelids. Of the iris?
c. The nostrils. *d.* The fauces. *e.* The face.	Minor portion of the fifth, Orbicularis, } from the facial. Levator alæ nasi, }	Facial respiratory movements. Sneezing, laughing, etc.

Incident branches.	*Reflex motor branches.*	*Excited actions.*
II. Pneumogastric, from:		
a. The œsophagus and stomach.	The pharyngeal plexus.	Suction and deglutition.
b. The mucous membrane of larynx.	The inferior laryngeal.	Closure of glottis, etc.
c. The bronchia.	The bronchial, etc.	Motions of air passages in respiration.
d. The heart, kidney, and liver.	The œsophageal and cardiac.	Motions of gullet and stomach.
III. Glossopharyngeal, from: Base of tongue and membrane of pharynx.	The pharyngeal plexus of the pneumogastric.	Associated movements of tongue and pharynx in deglutition and rumination.
IV. Posterior spinal, from		
a. The general surface.	The spinal accessory.	Movements of muscles of respiration.
b. The glans penis and glans clitoridis.	Diaphragmatic, Intercostal, Abdominal, } from the spinal.	Expulsion of fæces, urine, and semen; and of the fœtus.
c. The anus. *d.* The cervix vesicæ. *e.* The cervix uteri.	The sphincters, expulsors, ejaculators, Fallopian tubes, uterus, etc., } from the sacral.	Retentive movements of sphincters—of the cardia, of the valvula coli; of the anus, bladder, neck of uterus? and vesiculæ seminales.

Tone and irritability of the muscular system.

This table is compiled from data contained in Marshall Hall's work "On the Diseases and Derangements of the Nervous System," the excited actions being placed opposite to those divisions of the first two columns with which they are most obviously connected. The excited actions in the third column are not produced by irritation of the incident nerves of the first, but correspond more closely with the action of the reflex motor branches of the second. Thus, the incident excitor branches of the nostrils, when irritated, give rise not merely to the facial respiratory movements, but also to violent action of the muscles of respiration; and irritation of the bronchial incident nerves excites not only the muscular fibres of the bronchial tubes, but the muscles of expiration also, to the act of coughing.

429. The following table presents the pathology of the true spinal system; also in accordance with the views of Marshall Hall:

Pathology of the True Spinal System.

Diseases of the Incident Nerves.

I. Dental, gastric, and intestinal irritation in infants.
1. Crowing inspiration.
2. Strabismus, spasm of fingers and toes, strangury, tenesmus, etc.
3. Convulsions.
4. Paralysis.

II. Gastric, intestinal, and uterine irritation in adults.	1. Hysteria. 2. Asthma. 3. Vomiting, hiccough, etc. 4. Epilepsy. 5. Puerperal convulsions.
III. Irritation of textures supplied with nerves of common sensation.	1. Traumatic tetanus. 2. Hydrophobia, etc.

Diseases of the Reflex or Motor Nerves.

I. Spasm.

a. Spasmodic tic.
b. Torticollis.
c. Contracted limbs, etc.

II. Paralysis.

Diseases of the Spinal Marrow itself.

I. Inflammation and other diseases.
II. Diseases of the vertebræ and membranes.
III. Counter-pressure, etc., in diseases within the cranium.
IV. Centric epilepsy, tetanus, etc.
V. Convulsions from loss of blood, etc.

430. As we have seen, the condition of the nervous system and that of other functions of the body reciprocally affect each other; but this mutual dependence is so strikingly displayed in the case of the circulation as to merit further consideration.

431. The effect of the emotions and passions, and of all violent exertions of the body, on the heart, is a matter of daily observation; and so surely does the circulation participate in every change of the nervous system that it becomes the best test of its degree and amount. Every violent exertion, or long-continued exercise of the muscles, strongly excites the pulse; and rest not only restores the number which it had before the effort, but still further reduces it. The various causes of excitement to which we are exposed affect the circulation in the same way; and it is the fatigue thus produced that causes the pulse to fall toward evening, to regain its frequency when the body has been refreshed by sleep. Precisely the same effects are produced by disease. Thus, in febrile affections the pulse during the height of the disorder is much more frequent than in health, but during convalescence falls many beats below its natural frequency, to regain it as health and strength return.

432. Another remarkable fact established by careful observation of the pulse is, that it is much more affected by all causes of excitement when we are in full possession of our strength, than when exhausted by fatigue. Thus all stimuli—muscular exertion, food, drink, and even mental application—have a much greater and more enduring effect on the circulation in the morning than at night.

433. But there are states of debility in which the heart's action is

more frequent than in health. This occurs in an advanced stage of convalescence, when the patient begins to recover strength, and also in the decline of febrile affections, so long as any degree of fever continues. A greater degree of debility in the absence of actual disease is characterized by a very small and very frequent pulse ; but such debility is rare, except as the consequence of diminution in the quantity of the blood, whether from hemorrhage or from excessive discharges.

434. When nervous exhaustion is accompanied by local disease, whether functional or structural, that state of system exists to which we give the name of *irritation.* It occurs in slow convalescence from fever, when some local affection supervenes; as an immediate consequence of severe injuries in subjects weakened by disease or bad habits of life, and as a more remote consequence in sound constitutions, the injury itself producing in these the same nervous exhaustion which bad habits or previous disease had occasioned in those.

435. Another example of the action of the nervous system on the circulation is afforded by that temporary arrest of the heart's action known as *syncope,* or fainting, brought about, as it may be, either by violent shocks, originating from without, as in accidents, or from within, as in violent emotions. Sometimes the heart is paralyzed by the shock, and death results.

436. The movements of the heart are indirectly influenced by derangements of the pneumogastric nerve; hence, when the functions of the centre in which this nerve originates are interfered with by cerebral effusions, or by injury of the medulla oblongata, the circulation through the lungs is impeded, and the action of the heart embarrassed. It has also of late been assumed that the cardiac branches of the pneumogastric have a restraining or inhibitory influence on the action of the heart, but we regard the evidence on this point as unsatisfactory.

437. The effect produced on the nervous centres by changes in the circulation is more important even than those which the circulation suffers by alterations in the state of the nervous system. The exhaustion that follows strong nervous excitement has its counterpart in that produced by loss of blood, which causes syncope or death, partly by depriving the heart of its stimulus, and partly by paralyzing the nervous centres.

438. In healthy persons loss of blood occasions debility proportionate to the loss; but in persons afflicted with local disease, or of a broken constitution, the debility reinforced by nervous excitement becomes *irritation.* The same effect follows when the quantity of the blood is diminished by profuse discharges, such as leucorrhœa or diarrhœa, or by the excessive and continued drain of natural secretions, as in menorrhagia, and in prolonged suckling. But the puerperal state, combining, as it does, a local affection, nervous exhaustion, loss of blood, and a sudden disturbance of the equilibrium of the fluids, presents the highest development of this state of irritation.

439. In this condition of irritation, as in that originating in the nervous

centres themselves, the circulation is affected, and the frequent quick pulse is easily excited by emotion, or by strong and sudden impressions on the organs of sense. The functions of the brain also suffer; and, according to the degree of irritation, mental excitement, delirium, or mania occurs. The nervous influence conveyed to the muscular system betrays the same derangement by restlessness, jactitation, convulsions, and spasms in the voluntary muscles, and frequent or irregular breathing, laughing, crying, sighing, sobbing, and yawning, in those of respiration. The nerves of sensation also participate in the general derangement, and there are intolerance of light and sound, excessive sensibility of surface, and acute reflected pains in the walls of the chest and abdomen. The stomach likewise shows its sympathy with the nervous centres by nausea, vomiting, or hiccough.

440. Such are the phenomena of irritation, whether originating in the nervous system or in the circulation. It is a state aggravated by depletion, but relieved by remedies that impart strength while they allay excitement.

441. The influence of the nervous system over muscular movements has already been alluded to, and two classes of movements have been described, the involuntary and the voluntary. In disease, disordered contractions both of the voluntary and involuntary muscles are of frequent occurrence; the voluntary muscles performing involuntary contractions, and the involuntary becoming the seat of spasm.

442. In a few instances some portion of the involuntary muscles has been brought by peculiarity of constitution, or by habit, more or less under the control of the will. Of this the well-authenticated case of Colonel Townsend, who possessed the strange faculty of stopping the beat of his heart at will, affords an example.

443. The most striking examples of involuntary actions of voluntary muscles occur in chorea, hysteria, epilepsy, catalepsy, convulsions, tetanus, and hydrophobia; of which diseases some depend on the direct influence of the nervous centres, but the greater part are examples of reflex action.

444. When the contractions abide in the same muscles, producing a state of continuous rigidity, they are said to be *tonic;* when the muscles are alternately contracted and relaxed, they are called *clonic.* Tetanus, hydrophobia, and catalepsy are examples of *tonic* spasm; chorea, hysteria, epilepsy, and convulsions (unless the term is qualified by such words as *rigid* or *tetanic*) are cases of *clonic* spasm.

445. In chorea and hysteria, voluntary and involuntary impulses are strangely blended; but the will exercises a different degree of control in the two cases. When the patient in chorea wills a movement, the involuntary action, mixing with the voluntary effort, causes grotesque distortions, which attempts at restraint only increase; but the movements of the hysteric patient are less grotesque, though more violent, and can often be restrained by a strong effort of the will.

446. Convulsions are examples of involuntary contraction, commonly due to reflex action; but when they follow the loss of blood they probably arise from the suspension of the will. Thus, left to themselves, the stronger muscles prevail over the weaker. The flexors, which are the stronger, contract; the extensors, being put on the stretch, are in their turn brought into action, and thus an alternate or clonic contraction of the two sets of muscles takes place; but the flexors at length overpower the extensors, and if death ensue, the fingers and toes are found flexed.

447. The nerves of sensation, like those of motion, are subject to various derangements. Sensation may be lost (anæsthesia), or exalted (hyperæsthesia), or perverted (noseræsthesia). The loss of sensation which sometimes accompanies palsy is an example of anæsthesia affecting the nerves of touch; and amaurosis, of anæsthesia of the optic nerve. Intolerance of light and sound, and violent hunger and thirst, are examples of hyperæsthesia. The strange pains and anomalous sensations of hysteria and hypochondriasis, are instances of noseræsthesia.

448. In some hysteric females there seems to be diminished sensibility of the nerve of touch, with increased sensibility of other nerves, the sensibility appearing to be withdrawn from the one to be concentrated in the other. Hence some of the strangest phenomena of nervous affections, including those induced by the manipulations of the mesmerizer and electro-biologist.

449. There still remain to be considered two functions closely dependent on the nerves, and originating in the changes which are constantly taking place in the fluids and textures of the body—the generation of heat and electricity.

450. *Animal Heat.*—The heat of the body is due to the combination of the hydrocarbon of the food, or of the body itself, with the oxygen of the air. This combination occurs in the minute structures of every part of the system by means of the oxygen absorbed by the lungs. As the glands, the nerve matter, and the muscles are the parts chiefly engaged in chemical action, it follows that the temperature of these parts exceeds that of the rest of the body, and that the venous blood which flows from them is warmer than the arterial blood which passes into them. Thus, while the blood which leaves the liver is about 101° Fahr. (38.5 Cent.), that distributed to the body generally is about 98° Fahr. (37° Cent.), which may be taken as the mean average temperature of the body. Owing to the regulating influences of the skin and lungs, man, with suitable food, shelter, and clothing, is able to maintain this temperature, without appreciable variation, on any part of the earth's surface. A rise or fall of 2° is indicative of some morbid influence.

451. The temperature of those internal parts which are most accessible —viz., the mouth and rectum—is about 97½° or 98½° Fahr. That of the external parts is somewhat lower, and it has been observed to differ in parts near to and remote from the heart: thus, Dr. J. Davy observed that the temperature of the axilla being 98° Fahr., that of the loins was 96½°,

that of the thigh 94°, that of the leg 93° to 91°, and that of the sole of the foot 90°. The temperature of the blood was about 101°.

452. In disease great deviations from the standard are observed both in excess and in defect. Inflamed parts are found to have as high a temperature as 105° or 107°, and the heat of the whole surface may reach the same degree in high fever. In continued fever—specific or symptomatic—the temperature rarely rises above 105° or 106° Fahr. (41° Cent.), but 112° Fahr. (44.5 Cent.) has been recorded in some cases. Immediately after death a rise of from 1° to 3° is occasionally observed. On the other hand, in morbus cæruleus and in the cholera, the temperature has been observed as low as $77\frac{1}{2}$° or 77° Fahr.

453. In most diseases the temperature bears a pretty exact proportion to the pulse; but remarkable exceptions to this rule have been observed, and notably in cases of fever. Thus, in fever a pulse of 45 has coincided with a temperature of 105°; and in hydrocephalus a pulse of 60 or 70 with a temperature of 100°.

454. *Electricity.*—The facts ascertained with regard to free electricity in man are the following: No two parts of the body, excepting those that exactly correspond on the two sides, are in the same electrical condition: as a general rule the electricity is positive, but in the female more frequently negative than in the male; it is more abundant in persons of a sanguine than in those of a lymphatic temperament; greater in the evening than in the morning; greater when the temperature of the body is high than when it is low: it is increased by spirituous liquors, and reduced to zero in rheumatic affections. The free electricity of the body is generally of very feeble intensity; but in peculiar states of system sparks have been given out in great abundance. There exists in the nerves of all animals, independent of all mechanical and chemical actions in the body, or external to it, a natural electricity, circulating in closed currents from the central parts of the nerve fibres which are in a − condition, to the surface, which is in a + state. There is, in fact, an electrical antagonism between the transverse and vertical sections of the nerve. The same phenomena are presented in muscular fibres, but they are no doubt due to the nerves contained within them.

5. MENTAL PHYSIOLOGY AND PATHOLOGY.

455. Mental disorders more or less permanent, and more or less dependent on bodily disease, are of common occurrence, and some of the most difficult and responsible duties of the physician have relation to these. Hence the physiology and pathology of the brain claim his most attentive study.

456. Indeed the brain, the mind's instrument, built up and nourished as other structures are, deriving its supply of blood from the same centre, through the same intricate network of arteries and veins, is affected by every change in the composition of the blood, and in the balance of the

circulation; and is subject to like functional and structural diseases with other organs of the body.

457. Between brain and brain, as between body and body, it is reasonable to expect important original and acquired differences: original differences in size, shape, and consistency, and others more difficult to define, resulting from temperament, diathesis, and idiosyncrasy, from age, sex, and race; and acquired differences, due to climate, residence in town or country, education, occupation, and habits of life.

458. Many physical agents indeed, and especially excitement, fatigue, dissipation, intemperance, and inaction, act on the brain and nervous system more promptly and forcibly that on any other part of the body. Many poisonous agents, too, chiefly affect the nervous system, and prove fatal by the functional disturbance to which they give rise.

459. Again, the brain is influenced by inaction, wholesome exercise, or over-exertion, according as education is neglected, promoted, or enforced in early life, and in proportion to the necessity that exists for self-culture and labor in after-life.

460. If, then, we consider the brain from this twofold point of view (as a constituent part of the body, subject to all the influences by which it is affected, and as the material organ of the mind developed by mental exercise), we shall be prepared to find the differences between mind and mind, in health and disease, equalling and even surpassing those already pointed out (§ 87) as existing between body and body.

461. The brain, as already stated (§ 395), is the centre both of intelligence and of action, to which all sensations are referred, and from which all volitions emanate. It performs these functions subject to the condition that the nervous communication in both directions (inward from the organ of sense, and outward to the muscles) shall be unbroken.

462. Each organ of sense consists of three parts: 1, an external apparatus on which the impression of the object is made by contact, as in the senses of touch, taste, and smell, or by intermediate undulations or vibrations, as in the senses of sight and hearing; 2, a nerve transmitting this impression to the brain; and, 3, a portion of the brain itself set apart, as is probable, for taking cognizance of the impression thus produced and conveyed; and (as in the case of the two eyes) combining two distinct impressions into a single sensation. Each distinct apparatus of volition, such as the organs of speech and of locomotion, consists, in all probability, of similar constituent parts; 1, of a portion of brain in which the act of volition originates; 2, of a nerve or nerves by which the mandate is conveyed; and, 3, of a group of muscles by which the mandate, thus originated and transmitted, is obeyed.

463. The parts of the brain to which the sensations are conveyed, and from which the mandates of the will issue, are subject both to original deficiency and to the disabling effects of disease. Some persons, for instance, are unable to distinguish colors, others to recognize musical notes and intervals; and, on the other hand, a few, with perfect hearing

and well-formed organs of speech, are never able to articulate. Blindness from disease of the parts of the brain to which the optic nerves join themselves, and loss of speech from apoplexy affecting the base near the origin of the hypoglossal nerves are familiar examples of the disabling consequences of disease.

464. In tracing the path of sensation from without to within—from the impression on the organ of sense to the part of the brain that takes cognizance of it—we come in contact, so to speak, with two important operations, or faculties of the mind, *volition* and *memory*.

465. Volition plays an important part, not merely in directing all those muscular movements by which we provide for our subsistence and communicate with our fellows, but also in perfecting the work of sensation begun by the organs of sense. Without that act of volition, which, when brought to bear on our sensations, constitutes *attention*, no external object could be either distinctly perceived or recollected. On the other hand, without that power of reproducing sensations which constitutes *memory*, the more complicated acts of volition could have no existence. Hence, volition and memory appear to be closely linked together, to have their material instruments nearly connected in certain parts of the brain, and to be subject to simultaneous impairment by disease. But the will and memory are not limited in their operations to muscular movements and bodily sensations; for the will also directs and controls the operations of the mind, and the memory stores up and reproduces not sensations only, but trains of thought, processes of reasoning, complicated transactions, and the workings of emotion and passion.

466. The impressions made on the senses, in order that the mind may take cognizance of them, must therefore be accompanied by an act of volition known as *attention;* and whenever an object of sense becomes an object of attention, it is said to be perceived; in other words, sensation becomes *perception.*

467. Perceptions vary greatly in intensity in different persons, at different ages, and in different states of body; and the same difference exists in regard to that reproduction of perceptions which constitutes memory or recollection. In some persons, perceptions are reproduced with extraordinary quickness, vividness, and fidelity, while in others they can scarcely be reproduced at all; and one of the principal features of the mind in old age, and of the unsoundness peculiar to the aged, consists in the obtuseness of the perceptions, and the extreme difficulty with which they are recalled or reproduced. Perception and memory, indeed, bear a pretty exact relation one to the other. Objects best perceived are best remembered, and those that make little impression on the senses are not reproduced at all, or with great indistinctness.

468. In a few individuals, perceptions are reproduced with such vividness and fidelity that objects formerly perceived, are, as it were, painted on the retina, or transferred to other organs of sense by an effort from within. This perfect operation of memory, this power of depicting ob-

jects on the retina by the force of thought, is sometimes attributed to the imagination, and is termed *conception.* The poet Goethe had it during the whole of his life ; some few persons have it during childhood.

469. When this transference of thought to the organ of sense is involuntary, it constitutes *illusion.*

470. Objects of sense, then, make impressions varying in intensity with the attention bestowed on them. When the mind is preoccupied by thought, external objects make little or no impression, and are neither observed nor remembered ; and this preoccupation, or *absence of mind*, explains the eccentric acts of *absent* men, and some of the strangest actions of madmen.

471. By that effort of the will, then, which we call *attention*, we perceive objects with more distinctness, and reproduce perceptions with more facility. Now, sensations do not come into the mind singly, but in groups ; and our knowledge and experience of objects are compounded of many sensations. Thus, an orange produces a sensation of size, shape, color, weight, odor, taste ; and it is by an act of the *will* alone, in other words, by an effort of *attention*, that we single out any one of these sensations for a separate contemplation. This separation of one sensation from another is called *abstraction*, and reasoning on sensations thus separated is *abstract reasoning.*

472. This power of abstraction is needed to control and correct a directly opposite faculty, or mode of action, of the mind—that of *association.* As attention separates and isolates sensations one from another, so does *association* combine, and cause to reappear together, or in quick succession, those sensations or ideas which either took place simultaneously or successively, or have in any way been previously conjoined.

473. This tendency of sensations and ideas to reappear in the connection or succession in which they had previously entered the mind, may be obviated by an effort of the will ; but when such effort has repeatedly placed in combination or succession a number of sensations or ideas, this very combination or succession, though originally forced and voluntary, soon submits to the law of *association*, and a fresh effort is necessary to separate and disarrange them.

474. That repetition of sensations, thoughts, or movements, at first distinct, difficult, and voluntary, which at last transfers them from the dominion of attention to that of association, is called *habit*, of which, when this transference is complete, a man is said to become the slave.

475. By a faculty allied to, if not identical with, this of association, the mind also passes from one thought or recollection of an agreeable or of a painful character, to another of the same complexion.

476. Attention directed to different sensations or ideas in alternation or succession implies a faculty of *comparison ;* and this, in a being possessed of free will, implies also a power of choice.

477. This faculty of comparison is essential to the acquisition of

knowledge; as well as to the regulation of our actions. The impressions made on one sense must be compared with those made on another: the eye must correct the ear, and the sense of touch the eye, in order that we may form distinct and precise notions of the properties of objects. The ideas reproduced by the memory must also be contrasted with those caused by objects present to the senses. In the unsound mind, this power of comparison is lost, and intrusive memories or passing fancies are taken for realities.

478. Without the exercise of this faculty of comparison it would be impossible to make a single step in art or science. Orderly arrangement and scientific classification are wholly dependent upon it.

479. The objects grouped by the aid of this faculty are either the same or similar; that is to say, all their properties agree, or only some. Hence, we are able to say of any one object contained in a group or class what we are able to say of every other, either in respect of all its properties, or of that one property which formed the basis of the classification. Now this twofold process of constructing groups of individuals, and then affirming of them that they possess the property or properties which first led to their being thrown into groups, is the secret of all our knowledge—of science in its highest and its lowest forms.

480. When the objects thus grouped are simple and exactly alike, and when the words used to describe or define them can be understood only in one sense, our knowledge is absolutely certain; but when they are complex and only similar, and our words less precise, we must content ourselves with knowledge less definite and exact. There is only one class of objects to which the first part of this description applies, and these objects are mere *abstractions;* that is to say, they consist of the universal relations, as distinct from the special properties, of matter, such as space, time, number, position, direction; with regard to which we can make assertions that can neither be doubted nor denied, and definitions that cannot be misunderstood: and *Reason*, availing itself of these *assertions* or *axioms*, and of these plain definitions, and using a language at once condensed and intelligible, has built up that vast and wonderful fabric of abstract knowledge known as the *mathematics.*

481. Every comparison of one object with another, or of one object with a group to which it belongs, results in an inference expressed or understood; and these acts of comparison, with the inference drawn from them, constitute a process of *reasoning.* So that *reason* may be defined as the faculty by which we draw inferences from comparisons.

482. Now every process of reasoning, however complicated it may seem, consists of two assertions, containing the elements of a comparison, and an inference. The first assertion is, that a *group* of objects possesses this or that *property* or *properties;* the second, that an *individual* object belongs to that group; and the inference is, that, as a necessary and inevitable consequence, this individual has the properties of the group to which it is asserted to belong. These two assertions are technically called

premises (major and minor), and these, with the conclusion or inference, constitute the *syllogism* of the logician.

483. It is of the first importance to understand that when fallacies creep into a process of reasoning, they lurk in the premises, from which the inference or conclusion is a necessary consequence: and this is true of the operations of the unsound, as well as of the sound mind. For there are forms of unsoundness in which the power of making just comparisons is retained; the defective reasoning consisting in erroneous premises dictated by distorted perceptions, a perverted imagination, or over-excited feelings.

484. In some cases this power of drawing just inferences from false principles is seen in action. A patient who thinks that his food is poisoned, or that his body has been changed from flesh and blood into glass or butter, will not merely reason correctly on the false and incredible assumption, but will shape some at least of his actions in obedience to it.

485. There are, however, forms of mental unsoundness in which the reasoning faculty is so impaired, that even the formation of a simple syllogism is impossible. This happens in extreme cases of *dementia*, and in *idiocy*, or marked *imbecility*, in which the reasoning faculty has never been developed, even to the extent of comprehending or employing the simplest and easiest arguments. There is also a form of unsoundness characterized by complete *incoherence*, all the faculties being in a state of intense hurry and excitement, so that there is not, so to speak, breathing-time for the deliberate exercise of thought or reflection.

486. Some account has now been given of those organs and faculties by which we obtain knowledge; of the *senses* as its prime source; of *sensations*, as the impress of outward objects on the sensorium; of *perceptions*, as sensations recognized and strengthened by attention; of *conception*, as sensations without corresponding outward objects, reproduced by the intense operation of the mind itself; of *memory*, as the faculty by which sensations are less distinctly reproduced; of *attention*, as that by which sensations are strengthened, separated, or arbitrarily combined; of *association*, as the faculty by which sensations are linked together in their original or acquired relations; of *comparison*, as that by which sensations or ideas are contrasted; and, lastly, of *reason*, as the faculty by which conclusions or inferences are drawn from premises.

487. By the aid of these faculties alone we might have accumulated knowledge, and created arts and sciences; learnt much of the properties of matter, and got some mastery over it; and we might have made some advances in civilization. But without that inventive, suggestive, anticipating, exaggerating faculty which we call *imagination* or *fancy*, hypothesis, theory, poetry, and high art would have been impossible, and several forms of unsound intellect unknown.

488. The province of imagination would seem to be to select and arrange, in new and arbitrary combinations, forms, colors, sounds, descriptive words and phrases, and even the simplest and most abstract facts

of science, with a view to please, persuade, and amuse; to excite in the minds of others, by every kind of skilful combination and contrast, emotions pleasurable or painful. The most arbitrary of these combinations, when relating to matters of science, are termed hypotheses; when employed on trivial subjects, and directed to mere amusement, they are known as wit and humor. For practical purposes it may suffice to state that men exercise the imagination, or fancy, whenever, without intention to deceive, they make assertions incapable of proof, or unsupported by the concurrent testimony of other persons having the same opportunities of observation or experience with themselves.

489. Among the intellectual faculties, the imagination is the one which has the strongest affinity with the emotions and passions, for its operations, like theirs, are attended by excitement. It seems, indeed, to hold a middle place between the intellect and the passions; adding vigor and originality to thought, while it lends attraction to objects of desire, and gives intensity to every effort by which they can be compassed.

490. The powers or faculties of sensation, perception, conception, comparison, reasoning, and imagination, make up the sum of what are commonly known as the intellectual faculties. They may all be said to be dependent, primarily, on the senses, and to subserve the work of contemplation; but the faculties now to be considered lead direct to action. They are known as *passions* and *emotions*, as active and passive emotions, or as propensities and sentiments.

491. Between emotions and passions it is not easy to draw an exact line of demarcation; but it is usual to characterize *benevolence, veneration, hope, fear, grief, remorse*, as emotions; *lust, anger, ambition, vanity*, as passions. Although there is undoubtedly a distinction between them, yet they resemble each other in this—that they arise in the mind spontaneously whenever the object calculated to excite them is presented to it, whether from without by the *senses*, or from within by the *memory*. They do not spring from any process of *reasoning*, or from any exercise of comparison, but resemble instincts in the rapidity with which they spring up, the certainty with which they are directed to their objects, and the promptitude with which they act. When very strongly developed, or excited, they act even in persons of sound mind so quickly as to forestall the exercise of reason. Indeed *reason*, in the sense of the *reasoning faculty*, is in the very nature of things too slow in its movements to form an efficient check to passion, or a safe guide to emotion. To check the one and regulate the other is the work of *conscience*, an original and innate faculty, but one in some degree formed and moulded by instruction communicated in early life, and modified by the habits of society. Acting with all the quickness and precision of an instinct, it is the only faculty prepared to offer effectual resistance to the feelings and passions.

492. As the intellectual faculties exist both originally, and as a consequence of habit and culture, in very different proportions in different persons, so also do the *emotions* and *passions;* and just as education gives

acuteness to the perceptive and reasoning faculties, indulgence gives power to the emotions and passions, and restraint, on grounds of reason and right, supremacy to the conscience.

493. This sketch of the mind in its sound state would be incomplete if some allusion were not made to those first truths in which all sane men believe, without any conscious operation of the intellect. These are a belief in our own personal identity; in the real existence of objects of sense; in the uniformity of the operations of nature; and in the necessary connection of cause and effect.

494. Having now considered the faculties by which we gain and impart knowledge, the emotions and passions that move us to action, the conscience which counsels and restrains, and the first truths without a belief in which life itself could scarcely be preserved; our attention is naturally directed to certain states of the senses and of the mind, which, while they do not constitute mental unsoundness, often enter into that state as constituent parts, and serve to throw valuable light upon it. The first of these is *illusion* of the senses, among which *spectral illusions* are the most interesting.

495. All the senses, without exception, may become the seats of abnormal impressions—the eye, of bright or dark spots, and circles of colors; the ear, of humming, hissing, or blowing sounds, or distinct musical notes; the taste, of bitter, salt, or sour savors; the sense of smell, of unreal odors; and the sense of touch, of a feeling of local pressure, of heat or cold, of creeping, itching, pricking, and tingling. These false sensations are due to changes in the circulation through the brain, or through the nerve of sense.

496. Real objects are also apt to be exaggerated, or the reverse, in peculiar states of the organs of sense, or of the brain; and especially during slight febrile attacks, or in the early stage of convalescence from febrile disorders. Visible objects grow to enormous dimensions, or dwindle to the smallest size; and sounds seem lower or louder than they really are.

497. Like exaggerations often occur under the influence of fear, or other strong mental emotion. Good examples of this sort are supplied by two cases of theft. Sticks of a certain length were given to a number of suspected persons, with the assurance that the stick of the thief would grow by supernatural power. The culprit, imagining that his stick had actually increased in length, broke a piece off, and was thus detected. A farmer detected depredations on his corn-bin by making his men mix up a quantity of feathers in a sieve, assuring them that the feathers would infallibly stick to the hair of the thief. After a short time one of the men raised his hand repeatedly to his head, and so betrayed himself.

498. Another affection of the organs of sense allied to spectral illusions, consists in an extraordinary permanence of impressions. An instance in which the notes of a bugle haunted the ear nine months is mentioned by Abercrombie; and another, in which the spectrum of the sun impressed the retina ten years, is cited by Feuchtersleben from Boyle.

499. Impressions made on the senses may also be reproduced with great exactness after an interval of time. When Dr. Ferrier was about fourteen years old an interesting scene which he had witnessed during the day was, on entering a dark room, reproduced with great fidelity, and continued visible for some minutes.

500. From pictures on the retina, conjured up by an effort of the will, without corresponding external object, and from similar pictures the reproductions of vivid impressions previously made, the transition is easy to those illusions of the senses, and especially of the sense of sight, over which the individual affected by them has no control, and which have also no relation to objects previously perceived. Such illusions are of special interest; for, though quite compatible with perfect sanity, they are very common in cases of unsound mind.

501. Several cases of ocular spectra, so closely resembling real objects as to be distinguished only by the most careful exercise of comparison and judgment, are recorded in Sir David Brewster's "Natural Magic," and Sir Walter Scott's "Demonology and Witchcraft." A lady, whose case is related by Sir David Brewster, had the sense of hearing first affected, her husband seeming to speak to her, though not near her. Illusions of the sense of sight followed. She saw spectres of her husband, of a near relation in a shroud, of a deceased friend, and of a cat. But whether the illusion was of the ear or eye, she was quite aware of its real nature.

502. The woman in the red cloak seen by Mr. Abernethy's patient, the ghastly spectre which appeared to Lord Castlereagh at night, and the figurantès in green who drove Sir Walter Scott's young man of fortune out of England, all belong to this class.

503. Many remarkable men have been subject to these false impressions. The list comprises the names of Luther, Oliver Cromwell, Pascal, Goethe, Cellini, and Swedenborg. The student worn out by application, the religious enthusiast exhausted by watching and fasting, Silvio Pellico in his solitary confinement, the sailors of the Medusa suffering from mingled privation and excitement, the drunkard and the opium-eater, and persons under the influence of poisons of the narcotico-acrid class, have all afforded examples of spectral illusion.

504. Spectral illusions, too, are not rare in females at or about the change of life, when suffering from the group of nervous symptoms so common at that period (*mimosis inquieta*).

505. Spectral illusions may occur in either sex, and at any age from 4 to 80; and they are common in dreams, in delirium, and in madness. So common are they in this last condition, that Esquirol estimates at 80 per cent. the proportion of the insane who are subject to illusions of one or other of the senses. The insane are also very subject to a modified form of illusion, to which no better name can be given than *Illusive Transformations.* When they affect the sight, a keeper may be transformed into a good or bad angel, or the Deity himself. When they affect the

hearing, footsteps and other familiar sounds are changed to supernatural words of command.

506. Though illusions of the senses occur in persons both of sound and of unsound mind, they differ in this, that the madman believes in their reality, while the sane man soon learns their true character by the use of the other senses, or by some simple effort of comparison. There are, indeed, two ways in which these false perceptions may be corrected: 1, by confronting them with some real sensation, as in a case mentioned by Abercrombie, in which the lock of a door was seen through the spectral figure; and 2, by a comparison with the perceptions of other persons, as in Mr. Abernethy's case of the woman in red. A blind man subject to spectral illusions, was always struck with the circumstance that his figures moved about quite silently. The man of unsound mind neglects all these means of undeceiving himself, or cannot use them; or, if he entertain a doubt, he has some false reason to assign in favor of the reality of the supposed object of sense. A religious maniac, for instance, will think it impious to doubt.

507. Spectral illusions can sometimes be traced to thoughts or wishes which had previously passed through the mind. A patient recovering from a slight attack of fever, preceded by a severe family affliction, slept, during the heat of summer, in a room commanding a view of a large pond. One day he was seized with a great desire to bathe, and on the evening of that day a spectre appeared at his bedside, drew aside the curtains, and invited him to the water. This fact is rendered the more interesting by the circumstance, that though the patient's mind was so far recovered as to allow of his reasoning calmly about the occurrence, his mood of mind and expression of countenance changed in an instant, and he affirmed with great energy his determination to accompany the spectre should it appear to him again. A similar illustration of the occasional dependence of spectral illusions on the natural workings of the mind was afforded by an old lady, who, on two occasions, under the apprehension of the fatal issue of severe attacks of illness in her children, saw the whole paraphernalia of a funeral cross her room.

508. In that form of unsound mind known as *incoherence,* it is probable that illusions succeed each other with a rapidity only to be compared with the hurry of the thoughts to which the patient gives utterance.

509. Considerations of great interest and practical importance connect themselves with spectral illusions. 1. They are independent of the will; for they form the very staple of dreams in which the will is suspended, and they appear to the waking man not merely without the will, but in spite of it. 2. They are sometimes the false impressions of dreams continued in the waking state. 3. They are not merely vivid reproductions of former impressions on the senses, but new combinations and creations. 4. They often occur in persons in no way remarkable for talent or imagination. 5. They are often dependent on such changes in the balance of the cerebral circulation as occur in sleep, or in comparatively

trivial departures from health. In Nicolai they were clearly traced to the suppression of a hemorrhoidal discharge, and the immediate excitement of a fit of passion. 6. They are not mere reflex impressions on the retina, originating in the brain, and conveyed back through the optic nerve; for they occur in blind persons, and in cases in which the optic nerve has been found so injured or diseased as to be unable to perform its proper function.

510. These facts have an obvious bearing on the phenomena of unsound mind. If a change in that part of the brain by which impressions on the senses are perceived, or of the whole brain, can conjure up illusions so like realities as to require a strong effort of the sound mind to distinguish them, it is reasonable to suppose that those parts of the brain which bear to thought, emotion, and passion, the same relation as these perceiving portions do to sensation, or the entire brain, as the case may be, may undergo such changes as shall generate involuntary imaginations having no foundation in fact, words without meaning, emotions springing from no sufficient cause, and passions admitting of no control.

511. The same impressions on the organs of sense which, when they occur to waking persons, are called illusions, form, as already stated, the very staple of our dreams, which have an air of reality, partly due to the vividness of the impressions, and partly to their not being corrected by the judgment. But this is true not only of impressions on the senses: it holds good equally of mental operations, which often do not suffer by comparison with those voluntary and consciously performed in the waking state. In other words, that change in the state of the brain, whatever it be, which in waking persons occasions *illusions* of the senses, gives rise during sleep to every species of mental *delusion.*

512. These two terms, *Illusion* and *Delusion*, are here contrasted; and ought not to be confounded. The distinction between them will be made clear by the addition of three words to each: an *illusion* of the senses, a *delusion* of the mind. The word *phantasm* is a synonym of illusion. The term hallucination, being sometimes used in the sense of illusion, sometimes of delusion, ought to be allowed to fall into disuse. When an illusion of the senses continues to be mistaken for a real sensation, through inability to distinguish the one from the other, it becomes a delusion.

513. *Dreaming* is a state of mind in which illusions and delusions arise spontaneously while the senses are closed to the external world, and every voluntary mental effort is suspended, or imperfectly exercised.

514. Many dreams have for their exciting cause some bodily sensation, which becomes blended with fanciful accompaniments. A blister applied to the head suggests a dream of being scalped by savages; and a loud noise, a dream of being shot as a deserter. And, wonderful to relate, the sensation which really gives rise to the dream may seem the last link in a chain of events which would have occupied hours, days, or even years. Uneasy sensations may link themselves in like manner with imaginary scenes more or less appropriate. The most painful of the dreams due to

these causes are known as *nightmares*, in which the oppression at the stomach is converted into a hideous personality, from whose weight and pressure there is no escape; and the uneasy sensations in the rectum or bladder are woven into the texture of a dream, in which the impossibility of obtaining relief plays a prominent part. Excitement of the genital organs also gives rise to a peculiar class of dreams. But these uneasy sensations sometimes occasion dreams which resemble the sensation itself only in the one particular of being painful or distressing. Thus, a diseased hip-joint may give rise to distressing dreams having no reference whatever to the pain or to the part affected.

515. Recent impressions on the senses, or transactions in which the sleeper has been engaged, also stimulate the fancy to the invention of connected histories of unreal occurrences. Thus, a patient suffering from obstinate colic, which had not been relieved by mechanical means, received an encouraging opinion of his case, fell asleep under the influence of opium, and dreamed that his doctor was an engineer to a railway in which he was interested, and had assured him that there were no engineering difficulties that might not be overcome.

516. In many persons of unsound mind the mental operations bear an obvious resemblance to this class of dreams. Real sensations are mixed up, as in dreaming, with unreal accompaniments; and real events passing in the world receive fanciful interpretations, or are forced into unnatural relationship with their own thoughts. Thus a speculating madman, when railroads, the Oregon dispute, and the China war were dividing public attention, wanted to establish a company to run a railroad from Oregon to China.

517. There are many striking illustrations of the analogy between dreaming and madness in the painfully interesting autobiography of a religious maniac. The cold air that blows on him as he tries to suffocate himself, in obedience to the spirits that speak within him, becomes the breath of his sisters cooling him, and encouraging him to go through with his task. The familiar sensation of water trickling down the back is converted into the crystal tears of his father, whose venerable countenance he sees bending over him. His head is shaved, and he grieves that he has "received the tonsure of the Roman Catholic priesthood, a mark of the beast." The jets of gas from the fireplace become the utterance of his father's spirit, trying to save him, but obliged to return to be purified in hell-fire, from the contamination of his foul thoughts. The lowing of cattle conveys to him articulate sounds and sentences, and a creaking chair speaks to him in his father's voice.

518. Another convalescent from religious mania would look on his keeper at one moment as a man, at another as the Deity; and he habitually converted the man's footsteps into articulate words and phrases, and sometimes into commands to strike him. Believing it his duty to obey, he was surprised and confounded to find his violence resisted.

519. This analogy is also well illustrated by Dr. Gregory, in a case in

which insanity passed, so to speak, into dreaming. The maniac, for a week after his recovery, was harassed during sleep by the tumultuous thoughts and violent passions which had agitated him during his illness.

520. Dreams are sometimes accompanied by voluntary acts, and persons talk or walk in their sleep, or even commit acts of fatal violence in their half-waking state, in pursuance of the train of thought by which the mind is occupied.

521. Closely allied to this last-mentioned class of dreams is the state known as *somnambulism*, or *sleep-walking*, of which there are several varieties. In one form, the somnambulist merely goes through, with the precision of an automaton, a succession of acts to which he is accustomed in his waking state ; in another, he performs feats, and runs risks in doing them, which he would shudder at were he awake, such as walking on the edge of a precipice, or on the top of a lofty building. Or he will accomplish some intellectual task which had baffled him when awake.

522. Between this state of somnambulism and some forms of unsound mind there are analogies worth noting. In both there may be a remarkable increase of talent, a complete change of character, a distinct and separate affection of the intellect and of the moral faculties—an intellectual and moral somnambulism, an intellectual and moral insanity.

523. The change of character which sometimes happens during this state is well shown in the case of the Carthusian monk, who, while awake, was remarkable for simplicity, candor, and probity, but walked almost nightly in his sleep a thief, a robber, and a plunderer of the dead ; or that of a pious clergyman, who, in his fits, would steal and hide whatever he could lay his hands on, and once even plundered his own church ; or the case of the suicidal somnambulist mentioned by Ray, who escaped from his watchers, and was found suspended to a tree by his feet.

524. From dreaming and somnambulism the transition is easy to certain states of mind, due to temporary and transient causes, and closely resembling certain forms of unsoundness ; namely, *delirium*, *delirium tremens*, and *drunkenness*.

525. *Febrile Delirium* is present in many acute diseases, in fever, and in inflammation of the internal viscera ; it also follows severe injuries, such as burns, wounds, and fractures, and surgical operations, and it is a common effect of several poisons. There are two forms of febrile delirium. In the one the patient lies prostrate, utterly helpless, and muttering indistinctly. This form is present in the advanced stage of most cases of typhus and other fevers, and is known as muttering or typhous delirium. The other form, which sometimes attends the early stage of fever, is accompanied by great excitement, and often by great display of strength ; and it so closely resembles mania in some cases as to lead to the patient being treated as a lunatic. This is violent or furious delirium.

526. From the first form of delirium the patient is easily roused, by loud speaking, to short efforts of attention, and to the performance of

slight muscular movements, such as protrusion of the tongue; but he soon suffers a relapse. In some cases the attendants are able to discover that the mind is occupied by a dream, in which real personages play a consistent part; or they recognize an eager wish to carry on some business in which the patient was engaged before the disease set in.

527. *Delirium tremens* has some peculiarities worth noting. There are *three* leading effects of an abuse of spirituous liquors. The first is the common drinking fit, in which, when the excitement takes the shape of noisy anger, no mischief is done, because there is not power or steadiness enough in the muscles to commit the threatened violence. The second state has all the characters of a maniacal paroxysm, and is brought on in certain persons whenever they indulge to excess. It is a dangerous state of violent incoherence. The third form is sometimes the consequence of long habits of drinking abandoned for a time; but in the inhabitants of large towns, enfeebled by sedentary occupations, overwork, or want of proper nourishment, it may be the immediate consequence of a single debauch.

528. The characteristic symptoms of this state are given in Volume II.

529. Of the important and extensive subject of *unsound mind*, only the merest outline can be given in this place. There are three distinct states of mind demanding attention under this head: the *undeveloped*, the *degenerate*, and the *disordered*. The first consists in imperfect mental development, generally coinciding with a small and otherwise defective brain, and often with a stunted or deformed frame, dating from birth, or manifesting itself in infancy. The second supervenes in later life in persons previously of sound intellect, and consists in loss of mental power, sometimes sudden, but more generally gradual. The third consists in disorder of the mind, often attended by violence, and characterized by illusions, delusions, and excited or distorted passions.

530. The first is known as *Amentia*, the second as *Dementia*, and the third as *Mania*.

531. (1.) *Amentia*, comprises two sub-classes, *Idiocy* and *Imbecility*, both of which imply original defect of mind, but the first a greater defect than the second. The line may be most conveniently drawn by placing on one side, as Idiots, all who, being otherwise of defective intellect, cannot be taught to speak, on the other as Imbeciles those who can. The class of imbeciles comprises those whose mental development has been arrested in infancy or early childhood.

532. The idiot, thus defined, is an imperfectly developed being, with a mere animal existence, obedient to the simplest calls and impulses of nature, incapable of being taught, dependent on others for support, and able, at the best, to utter a few meaningless articulate sounds.

533. Imbeciles, on the other hand, have a certain amount of intelligence, understand what is said to them, and make themselves understood, remember common events, form habits of decency and propriety, and are equal to common household occupations, or to trades easily acquired.

The more intelligent can be taught to read, write, and cipher, and to know the use and value of money; and they may even attain to a certain excellence in mechanics, music, and the fine arts; but they cannot acquire the amount of knowledge, or practical skill, or exercise the prudence in the conduct of affairs, or the control over their passions, common among persons of their own rank and opportunities. The feeble control they are able to exercise over their passions, coupled with the imperfect idea they have of moral and legal obligations, explains the great number of imbeciles found among the criminal population.

534. Imbeciles in the upper ranks of society, being raised above the temptation to crime, make their defect of character felt by every kind of eccentric and irregular conduct, especially by pecuniary extravagance and by intemperance. Among the middle classes they furnish a full contingent of fraudulent debtors, swindlers, and forgers.

535. There is, in fact, a moral as well as an intellectual imbecility, counterparts of the moral and intellectual insanity presently to be mentioned; and a general imbecility, combining defective intellectual development with unbridled passions. Striking examples of moral imbecility, characterized by reckless extravagance, and an utter want of perception of the disgrace and wickedness of habitual debt, are to be found among the most eminent poets and prose writers.

536. The crimes of imbeciles are characterized by the same insufficiency of motive, the same folly in execution, and the same futile attempts at concealment, which mark other parts of their conduct.

537. Idiots and imbeciles afflicted with every variety of bodily infirmity and deformity, are to be found in certain unhealthy regions in all parts of the world, but especially in low damp spots, shut out from intercourse with neighbors, and subject to the evil of constant intermarriages. The evil reaches its highest pitch of intensity in deep alpine valleys, where the enlargement of the thyroid gland, known as *goître*, is superadded to other deformities. The persons so afflicted are called *Cretins*, and their malady is termed *Cretinism*.

538. (2.) *Dementia.*—This, as the name implies, consists of a loss of intellect, sudden or gradual: sudden, as when it arises from severe mental shocks or injury to the head; gradual, as when it follows attacks of fever, of inflammation of the brain, or of mania, and when it attends the decay of strength in the aged (*senile dementia*).

539. Sudden attacks of dementia produce a state of mind nearly allied to idiocy, the attention being sometimes rigidly fixed on the train of thought which accompanied the shock; while those which come on gradually (attended, as they often are, by epilepsy, and slowly increasing paralysis) resemble more closely the different degrees of imbecility. Indeed, many cases of so-called dementia are cases of imbecility, not recognized as such till the capacity comes to be tested and strained by affairs of difficulty, or till some mental shock develops more completely the weak points of the character.

540. In this class of cases it is often easy to trace the leading feature of the unsoundness, like a thread, through the whole history of the patient. An habitual debtor at school becomes an extravagant youth, and an embarrassed man; as an incipient madman he thinks he has a divine mission involving a large outlay of money, and he dies in the full conviction that he is the Saviour of mankind.

541. (3.) *Mania.*—This also consists of several sub-classes. Those commonly recognized are *general mania*, involving the intellect, passions, and emotions; *intellectual mania*, involving the intellect chiefly, if not exclusively; and *moral mania*, involving the moral nature to the exclusion of the intellect. There is another term in common use, especially in courts of law, namely, *lunacy*. It is sometimes wrongly used as a synonym of mania, and serves to remind us of a class of cases in which there are intervals of sanity and freedom from excitement. The more correct term for such cases is *mania with lucid intervals.*

542. Mania, whatever form it assumes, sometimes comes on suddenly as the result of mental shocks, intense mental excitement, severe injury to the brain, intoxication, or sunstroke; but more frequently it makes its approaches gradually during a period often of several years: the period of *incubation*. This is a time of painful consciousness to the patient, and of fearful misgivings or mischievous misunderstandings to the friends. The bodily health suffers with the mind, and the disease assumes its full development under the influence of some temporary excitement or disappointment.

543. *General mania*, or that form in which the intellectual and moral nature are simultaneously affected, may be described as a state of raving incoherence, combining a rapid succession of thoughts, often brilliant and original, with passionate excitement and intense restlessness. In many of these cases reference is constantly being made, in language of extreme violence and gestures of intense anger, to events that occurred at or about the time of the first seizure.

544. *General intellectual mania*, or that which attacks the intellect alone, is admitted to be of rare occurrence. There is, however, a form of it in which some one emotion or passion, such as pride, vanity, or love of gain, obtains such ascendency over the mind as to fill it with a host of intellectual delusions. Thus, patients in whom the passion of vanity is greatly excited, appropriate to themselves all the great intellectual performances which they have heard praised; those in whom pride is predominant imagine themselves a series of great men, or supernatural beings; and those in whom the love of gain is excited believe themselves engaged in extravagant and impossible speculations.

545. *Partial intellectual mania*, or *monomania*, otherwise designated as *melancholia*, may be subdivided into two classes, the one comprising those cases in which the unsoundness is not connected with any bodily sensation, the other in which such sensation forms an essential part of the malady. These latter cases are sometimes known as *hypochondriasis*, sometimes as *melancholia.*

546. Cases of monomania, without uneasy bodily sensation, are frequent; as in men who think themselves secretaries to the moon, or objects of persecution, or subjects of plots formed against their lives. In most of these cases the attack is gradual, but, like one form of dementia, it sometimes dates from a sudden shock. Such was the case of Simon Brown, a dissenting minister, who, having killed a highwayman in a struggle, fancied ever after that the Almighty had deprived him of his immortal soul, and, stranger still, that the reigning monarch had the power of restoring it to him.

547. The second class of cases of partial intellectual mania, or those connected with some disordered bodily sensation, are very common, and are remarkable not less for the extreme improbability of the interpretation the imagination attaches to the sensation than for its pertinacity. These cases are common in women, and often assume the shape of imaginary pregnancy. Thus, a woman with hydatids in the womb thought herself pregnant by the devil; and two females suffering from adhesion of the intestines after peritonitis, believed, the one, that a whole regiment of soldiers fought and struggled in her belly, the other, that the same narrow space was the scene of frequent interviews between the apostles and evangelists, the patriarchs and the pope. In men the imagination is not less active, nor the delusions less remarkable. Thus, one dyspeptic attributes his discomfort to a Caffre who got into his stomach at the Cape; others to men on horseback; and others, again, forgetting their sex, believe like the Scythians of old, that they have been transformed into women, and even become pregnant.

This form of unsoundness bears an obvious resemblance to those dreams which consist in an uneasy bodily sensation dressed up with imaginary accompaniments.

548. Bordering on this form of unsoundness, but less easily traced to disordered bodily sensations, are such cases as those of the man who was afraid of passing urine lest he should drown the town; or of those who fancy that they have noses of wax or glass, or feet of straw; perhaps also the case of the woman who was afraid to bend her finger, believing the world to hang on it, and that of the gentleman who thought himself the Crystal Palace, and, when Parliament decreed its removal, accused it of wishing to destroy him.

549. In the least unreasonable forms of this strange malady, as when patients believe that they have frogs, toads, and serpents in their stomachs, cures have been effected by ingeniously contrived surgical operations; and their complete success proves that the uneasy sensations may have entirely disappeared, and yet the mental malady remain.

550. One circumstance connected with this class of mental maladies, and which applies more or less strictly to all forms of unsoundness, is the consistency with which the patient supports the part his fancy has assigned to him. If a man believes himself made of glass, he moves about with caution; if of wax, he avoids the fire and sun; if he thinks his head has

been turned, he dresses accordingly, and if he fancies that poison is being put into his food, he will eat eggs or fruit which he has gathered, and drink only water which he has drawn from the spring.

551. Closely allied to this last form, in this as in some other respects, is that class of cases in which, in lieu of a painful bodily sensation, there is an uneasy state of mind, due primarily to some painful shock or disappointment; and passing into a belief that some person or class of persons, is conspiring against the patient. Luigi Buranelli and McNaughten were madmen of this class. Buranelli's delusion, however, was purely personal, while McNaughten believed himself an object of persecution by whole classes of the community. As these suspicions are commonly associated with that exaggerated estimate of the importance of certain bodily sensations which constitutes *hypochondriasis*, superficial or careless observers confound these cases with the more simple and harmless forms of that disease. But experience shows that these patients are very dangerous to society.

552. Intellectual disorder, occasionally attended by violent acts, is a result of the epileptic fit. Almost always after the convulsion is over the mind is heavy and confused, with great somnolency; but in a few cases this condition is absent or remains for only a short time, and is followed by bodily activity and a mental condition resembling that of acute mania. In this state the angry passions are sometimes highly excited, and the patient becomes extremely dangerous.

553. The form of mania known as *moral mania* consists in "a morbid perversion of the natural feelings, affections, inclinations, temper, habits, and moral dispositions, without any notable lesion of the intellect, or knowing and reasoning faculties, and particularly without any maniacal hallucination." When combined with a like affection of the intellect it becomes *general mania*. It usually precedes the intellectual form, the delusions of the intellect springing out of a morbid perversion of the feelings. Let this case be taken as an illustration. A solicitor, who, for many years, had conducted his business to the satisfaction of his partners and clients, had during the whole of that time tortured an unoffending wife by acts which no author would dare to commit to writing. At length he had an attack of acute mania, and claimed to be the Deity, the Saviour, the King of England, the heir apparent, and other dignitaries incompatible with each other. From this attack he recovered, had a speedy relapse, showed signs of softening of the brain, and died imbecile and paralytic.

554. Moral mania, like intellectual mania, may be either *general* or *partial*. Of *general moral mania* Frederick William of Prussia, father of Frederick the Great, affords an excellent example, combining drunkenness, household tyranny, religious austerity, disgusting personal habits, and repeated attempts at murder and suicide, with an intellect by no means wanting in power or culture.

555. *Partial moral mania* consists in the excitement of some one pas-

sion or propensity to a degree beyond the control of the higher faculties. In many cases the intellect and conscience remain intact, leading to struggles of which it is impossible to exaggerate the misery. The forms of this partial moral mania generally recognized are *kleptomania*, or a propensity to theft; *erotomania*, or amorous madness (in females, *nymphomania;* in males, *satyriasis*); *pyromania*, or a propensity to incendiarism; *dipsomania*, or a propensity to drunkenness; *homicidal monomania;* and *suicidal monomania;* to which might be properly added, an irresistible propensity to lying and begging, unconquerable pride, irrepressible vanity, unappeasable gluttony, and that most horrible form of it, *lycanthropy*, or wolf-mania. Of these, kleptomania and pyromania are most common in females; but cases of all the forms may occur in either sex.

556. Partial moral mania, whatever its form, is a disease of slow growth; but there is a class of cases known as *instinctive mania*, in which the disease manifests itself suddenly, and most frequently as *homicidal monomania*. The history of such cases is very remarkable. The victim of the insane violence is either a perfect stranger, or an infant incapable of offence, or a near relation to whom the homicide is tenderly attached. After the fatal act no attempt is made to escape, the deed is openly confessed, and its legal punishment courted and desired. But this insane impulse may assume a less simple form; the thirst for blood may be a chronic passion, and, like the uneasy bodily sensations and mental states just referred to, may clothe itself in the fantastic garb of monstrous intellectual delusions, as happened in the parricide Dadd.

557. The forms of mania, general and partial, intellectual and moral, present infinite varieties, and occasion the greatest perplexity to medical men when they are called upon to examine patients suffering from them, to give evidence concerning them, or to sign certificates. This perplexity is increased by the very nature of the legal questions which the physician is expected to answer—questions framed by men without experience of madness, and reasonably apprehensive of the injury which society might sustain if those who seem to be criminals should escape direct and speedy punishment; but addressed to those who know what madness is, who think that the truth has higher claims upon them than the safety of the public, or the satisfaction of those ignorant and thoughtless persons whose ready assent to received doctrines constitutes what is falsely called public opinion.

558. Mania, then, consists not in the loss of the mind's faculties, but in their perversion: the senses are the sport of illusions of which the patient cannot detect the unreality, and the mind of delusions of which he cannot perceive the inconsistency or impossibility; real sensations become, as in sleep, the materials of imaginary scenes; the realities by which the patient is surrounded are blended with illusions, and real persons made to undergo strange transformations in obedience to his delusions: so that many of his strange antics and acts of violence are mixed results of his illusions and delusions. It also appears that the state of the patient's

mind is subject to great variation from various external and internal causes; that the transition from one state to another is often as rapid as thought itself; that he is capable of exercising, for considerable intervals of time, complete self-control, so as to conceal his delusions; that, though sometimes easily imposed upon, he often evinces, in carrying out his insane purposes, all the forethought and preparation of a sane man; that in his wildest excitement he is often so far conscious of what he is doing as to recollect it many years afterward, his statements being confirmed by sane persons having cognizance of the facts to which he refers; and that he may be conscious of his state, and of the legal relations in which it places him.

559. In treating of the unsound mind, we have spoken of its various forms without connecting them with the diseased states of the body, or of the brain, out of which they often spring, and with which they are generally connected. To give a full account of all that is now known on this subject would occupy much space. Suffice it then to remark that as the undeveloped mind, in its forms of idiocy and imbecility, is rarely disconnected with a small and ill-formed brain, and the degenerate mind as rarely shows itself without a corresponding degeneracy of the brain-tissue (often in the form of softening): so the disordered mind is sometimes to be traced to remote functional disorder or injury (*e.g.*, a loaded rectum, or a thorn pressing on a nerve in the foot), and almost always connects itself with, or springs out of, excited circulation through the brain, as in cerebral inflammation, and in fever.

CHAPTER IV.

SYMPTOMS AND SIGNS OF DISEASE.

560. The symptoms and signs of disease of general importance are, the urine, the pulse, the heart's beat, and the respiration. Others, as the tongue, the sputa, the evacuations from the bowels, the attitude of the body, and the expression of the countenance, are more special. The symptoms and signs first named will therefore be treated in separate sections, together with the examination of the abdominal and thoracic cavities; the remainder will be treated of collectively. The contents of the present chapter may therefore be conveniently arranged as follows: 1. The Urine. 2. The Abdomen. 3. The Chest, and the Organs of Respiration and Circulation. 4. The Pulse. 5. The Respiration. 6. Other Symptoms and Signs of Disease.

1. The Urine.

Properties of Healthy Urine.

561. *Physical Properties.*—Healthy urine, recently voided, has the temperature of the body, is perfectly transparent, and of a light amber color, has a peculiar, but not unpleasant odor, which disappears on cooling, a salt taste, and a specific gravity ranging from 1005 to 1033.

562. *Chemical Properties.*—Reaction, slightly acid, due to the presence of acid phosphate of soda, and free lactic acid; remains unchanged when heated to the boiling point, and yields precipitates with the salts of baryta and silver, indicating the presence of sulphuric and phosphoric acids, and of chlorine. Hydrochloric, nitric, and acetic acids cause a separation of lithic acid. Oxalic acid produces a slight cloud of oxalate of lime, and the free alkalies throw down the earthy phosphates. Tannin produces a slight cloudiness.

563. *Decomposition.*—After standing some time, a slight cloud of mucus forms, and slowly sinks. An unpleasant odor is soon perceived, and the urine takes on an alkaline reaction, and effervesces with acids. Carbonate of ammonia is formed by decomposition of the urea, and ammonio-magnesian phosphate with phosphate of lime are thrown down. Part of these salts entangled by mucus form a scum. Decomposition continuing to advance, the odor becomes fetid; a blue or gray mould forms on the surface; and prismatic and feathery crystals of triple phos-

phate, and amorphous phosphate of lime, collect at the bottom, or cling to the sides of the vessel.

564. *Constituents.*—The *organic* constituents consist of urea, uric (lithic) acid, hippuric and lactic acids, salts of ammonia, and extractive matters, with small quantities of kreatin and kreatinin, and a trace of sugar. The *inorganic* consist of carbonic, hydrochloric, sulphuric, and phosphoric acids, combined with soda, potash, magnesia, and lime, with traces of silica, iron, and fluorine. These matters are dissolved or suspended in a variable quantity of water.

565. The variation in the quantity of water, and of the solid constituents due to age, sex, time of day, character of food, and amount of exercise, renders it impossible to give more than an approximate analysis of urine. The following represents its average composition:

Water,	950		
Urea,	...	24	
Uric acid,	...	0.3	
Kreatin,	...	1.25	
Kreatinin,	...	1.20	
Hippuric acid,	...	0.25	
Phosphates,	...	9	
Sulphates,	...	6	
Chlorides,	...	8	
	950	50	
Total,		—	1,000

566. *Quantity.*—The quantity voided in twenty-four hours varies in different persons, and in the same person at different times. The following are estimates of authors: Haller, 49 oz.; Simon, 45 oz.; Keill, 38 oz.; Christison, 35 oz.; Prout, 32 oz. (30 oz. summer and 40 oz. winter); Rayer, 21 to 57 oz.; Dalton's experiments on his own person, 48½ oz. (November), 51½ oz. (June). Average about 41 oz. It may, therefore, be stated at about two imperial pints.

567. The quantity of urine in health is chiefly determined by the liquid taken into the stomach; but it is affected by many other causes. It varies inversely as the pulmonary and cutaneous exhalation; and is greater in winter than in summer, on cold than on warm days, in moist than in dry air; during the day than during the same number of hours at night, and in the morning than in the evening. It is also increased by excitement and anxiety.

568. In disease, also, the urine is increased whenever the pulmonary and cutaneous transpiration is suppressed, excepting only those cases in which all the secretions are simultaneously diminished by high febrile action. In the cold stage of ague, under strong nervous excitement, and in hysterical paroxysms, an increased flow takes place. This increase, which may amount to 30 or 40 pints daily, is not accompanied by any change in the solid constituents. But in other cases the increase of water

is attended by increase of solid contents, or by the introduction of an abnormal constituent, such as sugar or chyle.

569. On the other hand, the urine is diminished by increase of the cutaneous and pulmonary transpiration, by profuse diarrhœa, and in cholera; by hemorrhage; in dropsy; in many forms of acute inflammation; and in the inflammatory stage of fever. It is suppressed, or greatly diminished, in inflammation of the kidney, and under the operation of active irritant poisons.

570. The quantity of the solid constituents is also subject to considerable differences in healthy persons. The most important constituents, urea and uric acid, are at a maximum in men in the prime of life, less abundant in females, and at a minimum in old age and childhood. They are increased by exercise and diminished by rest, increased by animal diet, and diminished when vegetable food only is taken.

571. *Density.*—This ranges from 1005 to 1033, and averages 1020 or 1025. Simon assigns it a range of 1005 to 1030, and an average of 1012; and Dr. J. C. Gregory a range for the adult of 1005 to 1033, the greatest range in the same individual being 21, and the ordinary range 15 degrees. The average deduced from 363 experiments on 50 individuals was 1022.5, and from 5 individuals, whose urine was examined between 20 and 50 times each, 1025.2.

572. The urine is more dense in males than females; and the density increases from childhood to manhood, to fall again in old age; it is increased by hot weather, much exercise, free perspiration, a dry diet, nitrogenous food, and during sleep. It is diminished by cold, sedentary habits, a watery diet, vegetable food, and acids; also by alcoholic fluids. It is at its average in the morning on waking; falls considerably after breakfast; rises gradually after mid-day; sinks immediately after dinner; but in a few hours rises higher than at any other time: and in the course of the night gradually returns to its average.

573. The urine secreted after the digestion of food differs widely from that formed after fluids have been taken. The former, the "urina chyli," contains, according to Nysten, thirteen times as much urea, sixteen times as much uric acid, and four times as much saline matter as the latter, the "urina potus." It has also an alkaline reaction.

574. The density of the urine in disease may vary from 1001 to 1055; and as the density in health does not appear to fall below 1005, nor rise above 1033, it follows that any number below 1005 and above 1033 should be regarded as a sign of disease, and any number approaching either limit should attract attention. A less density than 1005 indicates an increase of water, with a decrease of some of the solid constituents. A greater density than 1033 affords a strong presumption of diabetes, though 1030–1035 has been observed in cases of increased secretion with excess of urea.

575. The *solids* discharged in the urine in twenty-four hours average less than an ounce and a half. In a vigorous healthy adult male they may

be taken at two ounces, or nearly 1,000 grains. In disease they have been known to rise as high as 36 ounces, and to fall as low as 11 grains.

576. The *color* of healthy urine is inversely as its quantity; when scanty it is high-colored; when abundant, pale. In the morning it is usually of a darker tint than later in the day. According to Schunck the color of the urine is due to two syrupy deliquescent yellow pigments which he has called *urian* and *urianine*. In disease the color bears some proportion to the quantity; but it is materially affected by diseased products which mostly render it turbid. It may be milky from the admixture of chyle, mucus, or pus, or of the earthy phosphates in excess; deep yellow, or greenish yellow, from bile or cystic oxide; dark red or purplish, from purpurin, as in inflammatory diseases; yellow-red, as in hectic and the sweating stage of ague; and brownish or cherry-red, from the admixture of the red particles of the blood. The normal pigments above mentioned are very easily decomposed by strong acids and alkalies, and give rise to brown or blackish deposits of melanic acid.

Several substances taken with the food, such as rhubarb, madder, beetroot, corn-poppy, and logwood, are also said to tinge the urine red.

577. The ingestion of either phenic or benzoic acids under certain circumstances leads to the formation of indigo-blue, which is metameric with benzoyl-cyanide (C_7H_5OCN). The benzoates of the alkalies, when strongly heated, yield benzoyl and phenyl-benzoyl (C_6H_5, C_7H_5O) showing the intimate relation between the phenic and benzoic compounds. The "black" urine observed in cases of poisoning by carbolic (phenic) acid is a case in point.

578. *Indigin* is an occasional constituent of the urine, and this explains the presence of indigo in this secretion, for by decomposition it yields indigo-blue, indigo-red, and indigo-brown; each of which is occasionally deposited from the urine.

579. The natural *odor* of the urine, best perceived when it is scanty aud high-colored, disappears with dilution. Excessive acidity intensifies the odor, alkalinity renders it sweetish and aromatic. It is altered by some kinds of food, such as asparagus; is sweet in diabetes mellitus; and has the odor of sweetbrier when it contains cystin; and that of violets after inhalation or ingestion of oil of turpentine, or food containing ginger. When the urine is retained in spinal paralysis, or decomposed in cystitis it assumes an ammoniacal and more or less putrid odor.

Examination of the Urine.

580. For microscopic examination we require a few conical glasses and a pipette. The deposits are allowed to collect for several hours at the bottom of the glass, a portion is then drawn off by the pipette, and a drop transferred to a glass slide, and covered with a fragment of thin glass.

581. *The specific gravity* may be roughly taken by the urinometer. If accuracy be required, the urine must be weighed in a 1,000 or 500 grain

bottle, or if the quantity be small, one of the capacity of 250 grains of water.

582. *Reaction.*—This is determined by *litmus paper*, the reddened paper being changed to blue by alkaline urine, and the blue litmus to red by acid urine.

583. The urine submitted to examination should be either an average specimen of the entire day, or the first voided in the morning. It should be protected by a cover, and care should be taken to avoid the introduction of extraneous matters. Those likely to be found in the urine are depicted in Dr. Beale's "Use of the Microscope in Clinical Medicine Illustrated."

The principal reagents and their indications are as follows:

584. *Heat* throws down albumen, and also excess of the earthy phosphates, but it dissolves the urates of soda and ammonia. *Nitric acid* throws down a dead-white precipitate of albumen; it precipitates uric acid after some hours, but when the mixture is heated dissolves it with effervescence; it also dissolves the oxalate of lime and the alkaline and earthy phosphates; it precipitates the coloring matter of bile of a green color, but if added in excess, it changes it quickly, first to a dingy red, and then to a brown; it also detects urea in excess, when added to an equal quantity of urine (sp. gr. 1020, and above, at 32° Fahr.), by the formation of crystals of the nitrate. Moreover, it produces a cloudiness in urine containing certain essential oils. *Hydrochloric acid* precipitates uric and hippuric acid, and throws down the coloring matter of the bile of a green color, whatever the quantity added. It also dissolves the oxalate of lime, cystin and the phosphates. *Acetic acid* produces a cloudiness in urine containing mucus; it dissolves the alkaline phosphates, and the phosphate of lime sparingly. *Sulphuric acid* added to warm urine containing sugar or albumen causes a deposit of carbon. *Ammonia* throws down the earthy phosphates as a white precipitate, and dissolves cystin. *Oxalic acid in solution* throws down a characteristic oxalate of urea. *Oxalate of ammonia* is used to detect the presence of lime. *Caustic potash* dissolves uric acid and the urates of soda and ammonia, and with the aid of heat disengages ammonia from the urate; it also tinges saccharine urine a dark-brown, and thickens purulent deposits. A *solution of sulphate of copper*, with excess of caustic potash, when heated with saccharine urine, gives a deposit of the red oxide of copper.

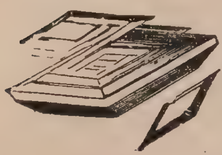
Fig. 18.

The following are the chemical and microscopic characters of the principal constituents of the urine in health and disease:

585. *Urea.*—This in excess gives a high specific gravity to the urine (1030–1035). If abundant, it may be detected by adding to a little urine in a watch-glass an equal bulk of strong nitric acid. The mixture, if kept in a cool place, deposits crystals of nitrate of urea. When the

quantity of urea is small, the crystals depicted in Fig. 18 may be obtained by evaporating urine over a water-bath to the consistency of syrup, and when cold, adding an equal quantity of nitric acid of sp. gr. 1.25. Glittering crystals soon form, and usually convert the mixture into a solid mass.

Fig. 19.



586. If we substitute a saturated aqueous solution of oxalic for nitric acid, we obtain crystals of the form shown in Fig. 19. Urea may easily be separated from the nitrate by the following process: Dissolve the crystals in a little water, and add an excess of barytic carbonate, evaporate to dryness over a water-bath, and dissolve out the urea by means of alcohol. The crystals are long, colorless prisms, and have a cooling taste like saltpetre.

587. *Quantitative Estimation of Urea.*—Both the chlorine and urea may be determined concurrently by the ingenious process devised by Liebig, in which mercuric nitrate is employed as an index to the quantities of both constituents. A solution of this salt precipitates urea from its solution, as an insoluble white precipitate composed of 1 equiv. of urea and 4 of mercuric protoxide. But when sodic chloride is present, no urea is precipitated, until the whole of the chloride is decomposed, corrosive sublimate and sodic nitrate being formed. As soon as the last trace of sodic chloride is thus decomposed, the urea begins to fall. In conducting the analysis four solutions are required. 1. Mercuric nitrate No. 1, for determining the amount of chloride. 2. Argentic nitrate, to precipitate the chlorine. 3. Mercuric nitrate No. 2, to precipitate the urea. These solutions are of such strength that 100 grain measures of each of the former two correspond to 1 grain of sodic chloride; and 100 gr. meas. of the latter to 1 grain of urea. 4. A solution of baryta, composed of 1 volume of cold saturated solution of baric nitrate, and 2 volumes of a cold saturated solution of baric hydrate. The first step in the process consists in precipitating the phosphates and sulphates, by adding to 2 fluid ounces of the urine 1 fluid ounce of the baryta solution and filtering from the abundant white precipitate. Next add two or three drops of nitric acid to the filtrate so as to give it an acid reaction. We now take 225 gr. meas. of the filtrate (= 150 of the urine) and ascertain the quantity of sodic chloride contained in this quantity. This is effected by adding the sol. mercuric nit. No. 1, until the mixture becomes a little cloudy (*i.e.*, until urea begins to fall), the point of saturation of the sodic chloride. Say 65 gr. meas. have been required, then 150 gr. meas. of the urine contain 0.65 gr. sodic chloride. Next take 450 gr. meas. of the filtrate and add twice as much of the sol. of argentic nitrate as that used of mercuric nit. No. 1—viz., 130 gr. meas. Pass twice or thrice through a filter, so as to separate the argentic chloride: then take half of the filtrate, $\frac{450+130}{2} = 290 = 150$ gr. meas. of urine; and from this, now deprived of phosphates, sulphates, and chlorides, precipitate the urea by the careful addition, with constant stirring, of sol. of mercuric nitrate No. 2. The first drop of the latter causes a

precipitate, and this increases until the whole of the urea has combined with the mercury. If excess of the mercurial solution have been added, a drop of the milky fluid gives an orange precipitate with solution of sodic carbonate. We must avoid this and get an indication of the exact point of saturation thus: Place a dozen large drops of the sol. sodic carbonate on a white plate, and from time to time convey on the end of the stirrer a drop of the mixture, and let it fall on the drop of sol. of sodic carbonate. As long as any uncombined urea remains in the mixture, a pure white precipitate is formed, but immediately the slightest trace of free mercuric nitrate is present, the precipitate assumes a primrose tinge. Here we must stop and read off the burette. Say 190 gr. meas. have been required, then 150 gr. meas. of the urine contain 1.9 gr. of urea and 1,000 gr. meas. 12.7: for 150: 1,000: 1.9: 12.7. For the analysis we shall want two or three burettes of about 500 grains capacity graduated into grain measures; a pipette to deliver 225 grains; and a second pipette graduated into 100 grain measures. These, and the standard solutions can be obtained from Mr. Griffin, Garrick Street, London.

588. *Uric Acid.*—There is sometimes so much uric or lithic acid in the urine that it separates on cooling, as a crystalline deposit. It is occasionally voided as gravel, and is a frequent constituent of urinary calculi, having every tint from light yellow to deep orange-red, or dark brown: hence the familiar names of "yellow and red sand." Occasionally it is quite colorless.

589. The urine which yields these deposits has generally a high color, an acid reaction, and a specific gravity of 1020 or more. The acid may be separated from urine which yields no deposit on cooling, by adding hydrochloric acid in the proportion of one or two drachms to six or eight ounces. The mixture after standing in a covered vessel for twenty-four to forty-eight hours, yields a red or reddish brown deposit of uric acid.

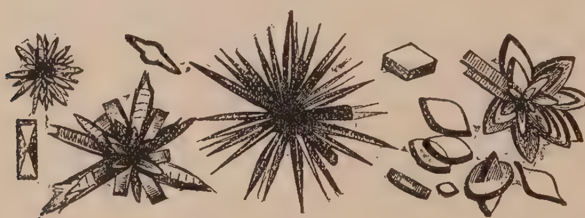
590. The crystals also vary in size from grains visible to the naked eye, and known as *cayenne pepper grains*, to a fine sand, in which the characteristic forms of the crystal are only to be detected under high powers of the microscope.

591. Uric acid is insoluble in hot and cold water; is not redissolved when the urine is heated; is very soluble in caustic potash, and is precipitated colorless from this menstruum by the addition of an acid in excess; it is dissolved by nitric acid with effervescence, and on evaporation to dryness yields a red or pink residue, which is changed to a rich purple (murexide) by vapor of ammonia. This is the appropriate test of its presence. Heated on platinum-foil uric acid burns with an odor of bitter almonds; when heated on porcelain it yields a crystalline sublimate to a superimposed disk of glass.

592. Under the microscope uric acid displays a great variety of forms. Its primary form is rhomboidal; but the angles are usually rounded off, forming lozenges; sometimes they are contracted, forming square plates

or cubes; sometimes they are very acute, forming needle-like prisms (see Fig. 20). All these forms occur both separately and in stellate groups. The effect of albumin and other matters in modifying the form of these crystals has been carefully studied by Dr. Ord (*St. Thomas's Hospital Reports*, 1870, p. 335). The quantity of uric acid excreted varies from 3 to 15 grains, and remains pretty constant under similar circumstances. Dr. Roberts ("Urinary and Renal Diseases," p. 63) found that the quantity secreted between the second and fifth hour after dinner is three times as great as at any other period. Mr. W. Vernon Harcourt gives the following as the best mode of estimating the quantity of uric acid: Neutralize a

Fig. 20.



fourth part of the daily urine with hydrochloric acid, if alkaline; with carbonate of soda, if acid; and evaporate to 12 drachms: add a mixture of 12 drachms of alcohol and 3 drachms of hydrochloric acid. After the uric acid has been precipitated, pour off the clear fluid, throw the deposit on a weighed filter, and wash it, first with alcohol, and then with a mixture of equal parts of acetic acid and water; dry and weigh. Dr. Pavy has lately introduced a method which consists in the power which uric acid possesses of decolorizing a solution of ammonia—cupric sulphate. So much of a standard solution of the latter corresponding to a grain of the latter.

593. *Hippuric Acid.*—This, which abounds in the urine of herbivorous animals, exists also in human urine. It may be obtained by evaporating a few ounces of urine to the consistence of syrup, and adding hydrochloric acid in excess. A mixture of uric and hippuric acids is thrown down. This deposit having been washed in cold water, is boiled with alcohol, which dissolves the hippuric acid. On evaporating the spirituous solution, the acid is deposited in long, colorless prisms.

594. The *Urates* or *Lithates.*—These deposits are often very abundant, generally falling as the urine cools, but occasionally they are voided with it. They are rarely quite white, sometimes bright red, and they may assume any tint from light yellow to dark brown. They are soluble in warm water and in warm urine. Alkalies dissolve them, and acids in excess throw down crystals of uric acid, which when treated successively with nitric acid and ammonia, yield the rich purple murexide.

595. *Urate of Ammonia.*—This salt is sometimes diffused through the urine, so as to give it the ropy appearance of muco-pus; in other cases it

forms a whitish or a reddish-brown deposit, known as the *lateritious* or *brick-dust* sediment. Its microscopic form is shown in Fig. 21, the ultimate particles being mere molecules.

Urate of ammonia shares with the other urates the properties enumerated in § 594; but it has the characteristic property of giving out ammonia, when heated with liquor potassæ. The granular deposit known as urate of ammonia often consists of the mixed urates of soda, ammonia, lime, and magnesia.

596. *Urate of Soda.*—This is rare as an unmixed deposit, but is sometimes met with in gout, and in fever patients treated with carbonate of soda. It has the chemical properties common to the urates. It tinges

Fig. 21.

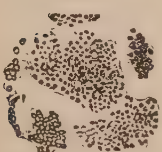


Fig. 22.

Fig. 23.

the outer flame of the blowpipe yellow. Under the microscope it presents the form seen in Fig. 22 and in Fig. 23, *a*; *b* being a rare variety (Beale).

597. *Oxalate of Lime.*—This is rarely seen as a granular deposit, but is often diffused through the urine as minute octahedral crystals. It is a common constituent of urinary calculi, and the material of the "mulberry calculus." It is insoluble in water, liquor potassæ, and acetic acid; but soluble in nitric acid, and converted at a dull red heat into *carbonate of lime,* identified as such by dissolving with effervescence in acids.

598. The crystals of oxalate of lime assume three forms: as regular octahedra, appearing like a square plate with a cross of light (Fig. 24); as

Fig. 24.

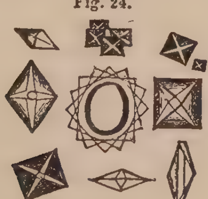


Fig. 25.

sharp elongated octahedra; and as dumb-bells (Fig. 25). The first is the usual form. The crystals are commonly so minute as to require the higher powers of the microscope. Both octahedra and dumb-bells are sometimes found adhering to casts of the urinary tubes. Octahedra so adhering are shown in Fig. 39, p. 129.

599. The *Phosphates.*—Phosphoric acid exists in urine in combination with alkaline and earthy bases, as, 1. Ammonio-phosphate of magnesia, or

the triple phosphate. 2. Amorphous phosphate of lime, or tribasic phosphate. And 3. Crystallized phosphate of lime. These deposits have the following properties in common. They generally occur in neutral or slightly alkaline urine; are white unless tinged with blood, are not dissolved by heating the urine which contains them, but are, on the contrary, thrown down by heat; are soluble in weak acids, but insoluble in water, in ammonia, and in liquor potassæ. The phosphate of lime is less soluble in acids. Heated separately, they fuse with great difficulty; but when combined in nearly equal proportions, the phosphate of lime and the triple phosphate fuse readily, constituting the *fusible calculus.*

600. (1.) The *Ammonio-magnesian Phosphate,* or *Triple Phosphate.*—On adding a few drops of ammonia to healthy urine, it becomes turbid, and deposits the triple salt combined with phosphate of lime. The same result may happen from the development of ammonia or its carbonate when the

Fig. 26.

Fig. 27.

Fig. 28.

urine is retained in the bladder for a long time, as in cases of paraplegia, or allowed to stand some hours out of the body. It is also common in diseased states of the mucous membrane of the bladder. The triple phosphate may present itself in any of the following forms: *a.* As a white crystalline gravel. *b.* As a thin iridescent film on the surface of the urine. *c.* As a dense white deposit closely resembling mucus. *d.* In masses or ropes resembling muco-pus. The common form is that of brilliant triangular or four-sided prisms with truncated ends (Fig. 26); as deposited from the urine by ammonia, it takes the stellar form (Fig. 27).

601. (2.) *Amorphous Phosphate of Lime* occurs as granules or molecules, like the amorphous lithates. They are sometimes found adhering to crystals of triple phosphate.

602. (3.) The *Crystalline* or *Bibasic Phosphate* was first recognized by Dr. Hassall. It occurs in the form of stellar clusters of long prisms with a square base (Fig. 28).

Fig. 29.

603. *Cystin.*—This curious substance is characterized by a large proportion of sulphur. It is not found in healthy urine, and is a rare product of disease. It constitutes a form of urinary calculus, but very seldom exists as a deposit. The urine which contains it is usually of a pale yellow tint, of low specific gravity, and of an odor resembling sweetbrier. The deposit of cystin is white, or of a pale fawn color, distinguished from white urate of ammonia by not disappearing on heating the urine which

contains it; and from the earthy phosphates by its insolubility in dilute hydrochloric or strong acetic acid. It is at once distinguished from all other deposits by its ready solubility in ammonia. The crystals are hexagonal plates of variable thickness, but generally thin and often superimposed, as in Fig. 29. The ammoniacal solution yields, on evaporation, the same well-formed hexagonal plates or prisms, but sometimes clustered crystals, as delineated. Cystin is often found associated with uric acid and the urates.

Quantitative Estimation of Phosphoric and Sulphuric Acids.

604. (1.) *Phosphoric Acid.*—This is wholly precipitated by uranic nitrate in the presence of sodic acetate and acetic acid as lemon-colored uranic phosphate, $2(Ur_2,O_3)\ P_2O_5 + Aq.$[1] To effect the separation we require, 1. A solution of uranic nitrate, 100 gr. meas. of which are equivalent to 1 grain of P_2O_5; this is made by dissolving 709.9 grains of the pure fused salt in water to make up 10,000 grain measures. 2. A solution of sodic acetate with free acetic acid, made by dissolving 1,000 grains of sodic acetate in 9,000 grain meas. of water and making up 10,000 gr. meas. by the addition of acetic acid. Take 500 gr. meas. of the urine and mix with it 50 gr. meas. of the solution of sodic acetate; warm, and then slowly and with constant stirring add from the burette the uranium solution, removing a drop from time to time with a glass rod, and letting it fall into a drop of solution of potassic ferrocyanide. So long as any phosphoric acid remains in the solution, no brown color appears; but it shows itself just as the point of saturation is overreached, when we stop and read off the burette.

605. (2.) *Sulphuric Acid.*—This is estimated as baric sulphate. To prepare the solution, take of powdered baric nitrate dried between folds of blotting-paper 305 grains, and dissolve in water, making up the solution to 10,000 gr. meas. 100 gr. meas. are equivalent to 1 grain SO_3. Take 1,000 gr. meas. of urine in a flask or beaker, add 12 drops of hydrochloric acid and boil, then let in the sol. baric chloride from a burette as long as the precipitate is seen to increase. The precipitate rapidly subsides and leaves a clear fluid, a drop of which must be taken from time to time and added to a solution of sodic sulphate. When the slightest excess of baryta has been added, a faint turbidity is produced in the latter. Then stop and read the burette.

606. *Chloride of Sodium.*—Common salt sometimes appears as crystals on evaporating a drop of urine on a glass slide. Their form is the cube, marked by lines or steps; but on hasty evaporation they have an irregular cruciform appearance.

607. *Chyle.*—Chylous urine, on cooling, gelatinizes spontaneously,

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[1] Neubauer and Sutton.

assuming the appearance and consistence of *blanc-mange.* It contains large quantities of albumen and fat.

608. *Fat.*—Urine may contain fat in a separate form, or as a constituent of chyle or milk. It is also frequently met with in the shape of oil globules attached to epithelial cells, or casts of tubes. (See p. 75, Fig. 11 *b*, and p. 129, Fig. 37.) The quantity of fat may be ascertained by evaporating a portion of the urine, dissolving the deposit in ether, evaporating the solution, and weighing the residue.

609. *Milk.*—Urine containing milk is turbid and pale, and contains fat-globules and colostrum corpuscles. Milky urine does not coagulate by heat, unless the quantity of lactic acid be large, or unless it also contain albumen. On adding to a little urine moderately warmed a few drops of acetic, dilute sulphuric, or hydrochloric acid, flocculi of coagulated casein are formed. The quantity of casein may be determined by collecting these flocculi, washing and drying them, and dissolving out the oil-globules by ether.

610. *Sugar.*—This may sometimes be detected by the taste, especially if we first evaporate the urine to the consistence of a syrup ; but this test is inconvenient in practice, and not to be depended on. The specific gravity of the urine affords certain evidence of the existence of sugar only when it exceeds 1.035, which is probably the highest figure for urine containing urea in excess. The specific gravity of diabetic urine ranges from 1.020 to 1.050. When the symptoms lead to a suspicion of the presence of sugar, it may be detected by one or more of the following tests:

(1.) *Trommer's Test.*—Add to half an inch of urine in a test-tube, three drops of solution of sulphate of copper (twenty grains to the ounce), then add a quarter of an inch of liquor potassæ. Hydrated oxide of copper is thrown down, but dissolves in the excess of alkali. On boiling the liquid, if sugar be present, the red suboxide of copper, varying from a light orange to a deep crimson tint, is thrown down.

(2.) *Fehling's Test-solution.*—This may be conveniently substituted for the sulphate of copper and caustic potash of Trommer's test. It is prepared by dissolving 34.65 grains of sulphate of copper in a drachm or two of distilled water, and adding it to a solution of 173 grains of tartrate of potash, and 80 grains of caustic soda in about an ounce of distilled water ; and making up the mixture to exactly 1,000 grain measures. 100 grain measures of the solution are equivalent to half a grain of grape sugar. In order to ascertain the quantity of sugar in a given quantity of urine, take 100 grain measures of Fehling's solution in a 2 ounce flask or porcelain capsule, dilute with three or four times as much water, boil gently and continuously, and deliver from a burette a little of the saccharine urine into it from time to time. In proportion as the sugar is added, the solution loses its blue color, and red suboxide of copper falls and rapidly subsides. When the process is complete the supernatant fluid has a faint brown tinge. If there be any doubt of the existence of copper in the solution, remove a drop, neutralize it by acetic acid, and add a drop of solution of

potassic ferrocyanide. A brown precipitate will occur if there be a trace of copper in the solution. If this prove to be the case, the mixture is to be again boiled, and a few grain measures more of the urine added. If the urine contain more than 1 per cent. of sugar, it should be diluted to half or one per cent., and the experiment repeated. Suppose 85 grain measures of the diluted urine have been required to precipitate the copper as suboxide, this quantity contains half a grain of sugar, 100 grain measures of the copper solution being equivalent to that quantity.

The following tests have been recommended, but are less free from objection than the foregoing :

(3.) *Moore's Test*, with *liquor potassæ*.—Pour the urine supposed to contain sugar into a test-tube, add half its bulk of liquor potassæ, and boil for one or two minutes. The urine assumes an orange-brown tint, of depth proportioned to the quantity of sugar.

(4.) *Crystallization Test.*—Evaporate the urine to the consistence of a thick syrup, and digest in hot alcohol. Pour the cooled alcoholic solution into a large test-tube, and allow it to evaporate spontaneously. The sugar will crystallize on the sides in white granules.

(5.) *Fermentation Test.*—On adding yeast to diabetic urine, and raising the temperature to 80°, effervescence takes place, a brisk discharge of gas ensues, and a yellowish liquid is formed, which has the odor of beer, and yields alcohol by distillation. One part of sugar in 1,000 parts of healthy urine of the density 1030 may be detected by this means.

Fig. 30.

(6.) *Torula Test.*—Expose the urine for a few hours to a temperature above 70°. A drop taken from the scum that covers the surface, and placed under the microscope, exhibits oval vesicles, which rapidly grow into a species of conferva, to which the term *torula* has been given. This formation, however, is not peculiar to diabetic urine. (Fig. 30.)

(7.) The *quantity* of sugar may be determined with a fair approach to accuracy by a modification of the fermentation test, which is thus performed. Fill a graduated tube with mercury, leaving space for little more than the requisite quantity of urine, which then introduce. Fill what remains of the space with yeast. Close the open end of the tube with the finger, reverse the tube in mercury, and expose it to a heat of 70° or 80° for twelve hours or more. Since the fluid thus introduced dissolves its own bulk of carbonic acid, the measure of the fermented liquid, added to that of the undissolved gas, gives the quantity of carbonic acid ; from which the weight of sugar is inferred by allowing one grain for every cubic inch of gas.

611. *Bile.*—Urine containing bile is of a deep yellow-brown color, and if the quantity be considerable, of a bitter taste. Its presence is readily detected—

(1.) By the gamboge color on dilution with water.

(2.) By *nitric* and *sulphuric* acids, which produce in the liquid an iri-

descent play of colors. To apply this test, a drop of the bilious fluid and a drop of the acid are placed side by side on a porcelain plate, and joined by the touch of a glass rod.

(3.) *Pettenkofer's Test.*—To a few drops of the urine on white porcelain add a drop of strong syrup, mix with a glass rod, and then place near it two-thirds of its bulk of pure sulphuric acid; gradually mix the two, spreading the fluid over a large surface of the cold porcelain so as to avoid the development of too much heat, which would cause a charring of the sugar. If bile be present a fine purple color will be produced.

(4.) A fourth test has been proposed by Schwertfeger. It consists in throwing down the bile as a yellow precipitate, by acetate of lead, and dissolving the precipitate in alcohol acidulated with sulphuric acid. To the green solution thus obtained, Pettenkofer's test may be applied.

Tests 1 and 2 are most expeditious, and, therefore, to be preferred.

612. *Kyestein.*—This, though not peculiar to pregnant women, is occasionally found in pregnancy. It consists of a film of fat, a matter resembling casein, and crystals of ammonio-magnesian phosphate. It forms on the surface of the urine in periods varying from thirty hours to eight days, but usually on the third day. The urine is either neutral or ammoniacal at the time of its formation. After standing some time the pellicle breaks up and falls to the bottom. The sediment has the disagreeable pungent odor of decayed cheese.

613. *Blood.*—Blood is sometimes voided with the urine in small defined clots, readily recognized; but, in other cases, it tinges the urine a bright red, brown, or bistre red. Minute traces give to acid urine a smoky, brownish appearance resembling weak tea. The color alone is not conclusive, as other coloring matters produce similar appearances; but its nature is easily ascertained, either by the discovery of blood-corpuscles under the microscope, or by the effect of heat and nitric acid, which throw down a dirty-brown coagulum, consisting of albumen blended with the coloring matter. The urine also assumes a bright red tint when treated with a strong solution of common salt.

614. *Blood-Corpuscles.*—When not dissolved in the urine, the blood-corpuscles form a dark brown-red sediment in which their forms may be detected by the microscope.

615. *Fibrin.*—This substance is voided in the form of casts of the tubes, or as a constituent of clots of blood. Coagula and flocculi of fibrin are readily distinguished from mucus by their amorphous appearance under the microscope, and the absence of epithelium.

616. *Albumen.*—This is very often found in the urine in quantities from 12 grains in a 1,000 grain measures of the urine downward. Its presence in acid urine is readily ascertained by boiling, which coagulates it. Boiling also precipitates any excess of phosphates. Hence it is always desirable to add a few drops of nitric acid, after boiling. Care must be taken to use a clean test-tube, for if the urine contain a trace of nitric acid previously, boiling does not precipitate the albumen. If the urine be alkaline,

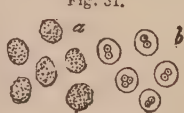
the albumen is best precipitated by the addition of a large quantity (one-fourth) of nitric acid to the cold urine. Some essential oils, such as cubebs, and oleo-resins, as copaiba, are eliminated by the kidney, and render the urine turbid on the addition of an acid. They are, however, easily separated by shaking the turbid fluid with ether.

617. The *quantity* of albumen is readily estimated thus: Counterpoise two filters and place one folded by the side of the other in a funnel. Take 1,000 grain measures of the 24-hours' acid urine; boil, throw hot on the filter, wash the filter with hot water, so as to get rid of all but a trace of urine, and then add fresh water and a few drops of nitric acid to dissolve any phosphates that may have been deposited with the albumen, and subsequently wash out every trace of acid and urine. Dry the filters, and when the albumen is quite brittle, weigh, using the folded filter as a counterpoise.

618. *Mucus.*—A little mucus is present in healthy urine without affecting its transparency. In disease it may be blended with it in any proportion, from a slight cloud to a quantity sufficient to cause it to pour from one vessel to another as a viscid ropy fluid; and when the quantity is considerable, and the result of acute inflammation of the mucous membrane, and especially when it is blended with an excess of phosphates, it may form a distinct deposit closely resembling pus. Urine containing mucus has generally an alkaline reaction, and is not coagulated by heat or nitric acid, unless albumen be also present; but acetic acid coagulates it.

619. *Pus.*—Urine containing pus is commonly either acid or neutral; and, on standing, deposits the pus as a distinct cream-colored layer, readily diffused through the fluid by agitation. The deposit is not dissolved by acetic acid; it is rendered viscid and more consistent by liquor potassæ, and, when shaken with ether, yields a quantity of fat. The urine, freed from its purulent deposit is coagulated by heat and nitric acid. In alkaline urine, pus has something of the viscidity of mucus.

Fig. 31.



Under the microscope pus presents a number of opaque spherical bodies, consisting of a cell-membrane inclosing nuclei, oil-globules, and minute granules. The addition of acetic acid renders the envelope transparent and the nuclei more distinct, as in Fig. 31, in which *a* represents the ordinary appearance of the pus granule, and *b* of the same granule on the addition of acetic acid. Mucus presents similar microscopic appearances, but the particles are not so distinctly granular.

620. *Diagnosis of Pus and Mucus.*—Much stress was once laid on the importance of distinguishing pus from mucus, and many methods were devised for effecting that object. But it is now well understood that, though there is a great difference between pus and healthy mucus, there is very little between pus and the mucus of an inflamed membrane. Purulent urine contains albumen, but mucous urine, as such, is free from it.

621. *Semen.*—Occasionally the seminal fluid which lines the urethra

after emission becomes washed away by the urine, and may be recognized in it by the spermatozoa (Fig. 32). The examination should be made soon after the urine is passed, with a quarter or an eighth power. The object must not be too strongly illuminated.

Fig. 32.

622. *Epithelium.*—This, as found in the urine, is of three kinds:

(1.) *Renal.* (2.) From the urinary passages. (3.) *Vaginal.* Renal epithelium (Fig. 33, *a*) is commonly present in acute nephritis. It is soon affected with fatty degeneration, in which condition the cells become opaque, and appear like spherules of dark aggregated granules. Epithelium from the bladder and ureter is represented at (*b*), that from the male urethra in Fig. 32; that from the vagina in Fig. 33, *c*.

623. Sometimes it is desirable to be able to recognize by inspection, and the use of one or two simple tests, the character and composition of an urinary deposit. The most common deposits may be classed as follows:

Fig. 33.

(1.) Red crystalline sediment—urine acid. Uric acid with coloring matter of the urine.

(2.) White crystalline sediment — urine neutral or alkaline. Triple phosphate.

(3.) White amorphous sediment—phosphate of lime.

(4.) Pink sediments—urine acid. Urate and phosphate of ammonia.

(5.) Yellowish or nut-brown sediment—urate of ammonia and soda, earthy phosphates, and coloring matter of urine.

(6.) Reddish-brown or lateritious sediment—alkaline urate (chiefly urate of soda), earthy phosphates (occasionally), coloring matter of urine, and alkaline purpurate.

(7.) Oxalate of lime. A scanty, white, powdery deposit, usually incumbent on a cloud of mucus.

(8.) Carbonate of lime. A heavy fawn-colored deposit.

(9.) Cystic oxide. Very rare.

(10.) Red particles of blood entire, or disintegrated into chocolate-brown molecules, pus, mucus, etc.

624. The substances referred to in 2, 3, 4, 5, and 6, consist of coloring matter with alkaline urates and earthy phosphates in variable proportions. These are easily distinguished, both from each other and from certain secretions which resemble them, by shaking up the sediment and applying heat. If the sediment dissolve, it consists of alkaline urates, chiefly urate of ammonia; but if the fluid remain turbid, it consists of the earthy phosphates, or of pus or mucus. These may be readily distinguished by the

addition of hydrochloric acid, which dissolves the phosphates, but not the pus or mucus. If urine containing urates also hold albumen in solution, the urine when heated first becomes clear, and then turbid.

625. *Casts of the Urinary Tubes.*—In diseases of the kidney considerable importance attaches to a microscopic examination of the urine, with a view especially to the discovery of casts of the urinary tubes. The casts, of which the chief varieties are represented in the figures, are best seen with a power magnifying about 200 diameters.

626. Fig. 34. *Epithelial cast,* composed of fibrin entangling epithelium and blood-corpuscles, and indicating "acute desquamative nephritis," a

Fig. 34.

Fig. 35.

Fig. 36.

Fig. 37.

Fig. 38.

Fig. 39.

form of disease not uncommon as a consequence of scarlatina, and which is analogous to the desquamation of the skin.

627. Fig. 35. *Granular cast,* composed of fibrin, with particles of disintegrated "epithelium, characteristic of chronic desquamative nephritis."* These casts are common in the urine of men who have had numerous attacks of gout, and they may often be detected long before any other sign of renal disease, albumen appearing at a later stage.

628. Fig. 36. *Waxy or hyaline casts,* sometimes deposited in the advanced stage of chronic nephritis, but sometimes also in acute nephritis.

629. Fig. 37. *Oily casts,* composed of fibrin, entangling oil-globules

and epithelial cells gorged with oil. They indicate degeneration of the kidney, the most serious and incurable form of Bright's disease.

630. Fig. 38. *Purulent casts*, composed of fibrin entangling pus-cells, and indicating suppurative nephritis ; a very serious and often rapidly fatal form of disease.

631. Fig. 39. *Blood casts,* such as occur in strangury and hæmaturia, after taking oil of turpentine. The blood is moulded in the kidney tubes, and affords unequivocal evidence that the hemorrhage was renal. The crystals attached to the cast are oxalate of lime. (The wood-cuts are from the drawings of Dr. George Johnson.)

632. In diabetes, and in other morbid states in which the urine is loaded with matter in excess or foreign to its normal composition, we may wish to estimate the quantity of solid matter it contains. This may be done by multiplying the excess of the specific gravity of the urine above that of water by the weight of the urine, and the product by 0.00233. By referring to a table in which the weight of solids in given quantities of urine of different specific gravities is stated, the amount of solids in the specimen under examination may be directly calculated from the measured quantity, which should be the whole amount passed in twenty-four hours, or a measured fraction of it. The first of the two tables given below presents the quantity of solid matter contained in 1,000 grains of urine of different densities ; and the second the weight of one pint of urine. The mode of using these tables will be readily seen from a single example. Suppose a patient to pass, in twenty-four hours, three pints of urine of the specific gravity of 1.030, it is required to ascertain the weight of solid matter voided in this period. 1,000 grains of urine, specific gravity 1.030, contain by Table I. 69.90 grains of solid matter, and a pint of urine of the same specific gravity weighs, by Table II., 9,012 grains. Hence $\frac{69.9 \times 9012}{1000}$ or 629.9 grains is the quantity of solid matter contained in each pint of urine ; and 629.9 × 3, or 1889.7 grains, is the total weight of solids voided in the twenty-four hours. This calculation gives us a sufficiently close approximation to the actual weight of saccharine matter in cases of diabetes mellitus.

TABLE I.

Solids in 1,000 *Grains of Urine of different Densities.*

Specific Gravity.	Solids.	Specific Gravity.	Solids.
1.001	2.33	1.008	18.64
1.002	4.66	1.009	20.97
1.003	6.99	1.010	23.30
1.004	9.32	1.011	25.63
1.005	11.65	1.012	27.96
1.006	13.98	1.013	30.29
1.007	16.31	1.014	32.62

Specific Gravity.	Solids.	Specific Gravity.	Solids.
1.015	34.95	1.033	76.89
1.016	37.28	1.034	79.22
1.017	39.61	1.035	81.55
1.018	41.94	1.036	83.88
1.019	44.27	1.037	86.21
1.020	46.60	1.038	88.54
1.021	48.93	1.039	90.87
1.022	51.26	1.040	93.20
1.023	53.59	1.041	95.53
1.024	55.92	1.042	97.86
1.025	58.25	1.043	100.19
1.026	60.58	1.044	102.52
1.027	62.91	1.045	104.85
1.028	65.24	1.046	107.18
1.029	67.57	1.047	109.51
1.030	69.90	1.048	111.84
1.031	72.23	1.049	114.17
1.032	74.56	1.050	116.50

TABLE II.

Weight of a Pint of Urine of Different Densities.

Specific Gravity.	Weight of one Pint.	Specific Gravity.	Weight of one Pint.
1.010	8837	1.031	9021
1.011	8846	1.032	9030
1.012	8855	1.033	9038
1.013	8863	1.034	9047
1.014	8872	1.035	9056
1.015	8881	1.036	9064
1.016	8890	1.037	9073
1.017	8898	1.038	9082
1.018	8907	1.039	9091
1.019	8916	1.040	9099
1.020	8925	1.041	9108
1.021	8933	1.042	9117
1.022	8942	1.043	9126
1.023	8951	1.044	9134
1.024	8960	1.045	9143
1.025	8968	1.046	9152
1.026	8977	1.047	9160
1.027	8986	1.048	9169
1.028	8995	1.049	9178
1.029	9003	1.050	9187
1.030	9012		

2. The Abdomen and Organs of Digestion.

633. *The Abdomen.*—To facilitate description, the chest and abdomen are divided into a number of distinct parts or regions by imaginary lines drawn from fixed points, as in Figs. 40 and 41.

This division is made, in the first place, by four horizontal lines passing round the body—the first (*a a*) at the level of the clavicles, the second (*b b*) at the level of the point of the ensiform cartilage, the third (*c c*) at the level of the cartilages of the tenth ribs, and the fourth (*d d*) at the highest points of the crests of the ilia. The abdomen is further subdivided into seven regions (three central and four lateral) by two vertical lines (*e e*) arising from the middle point of each groin, and meeting the horizontal line (*b b*).

The three central regions thus formed are named in the order from above to below, the epigastric, the umbilical, and the hypogastric; the

Fig. 40

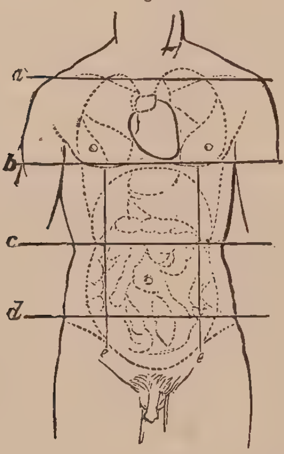
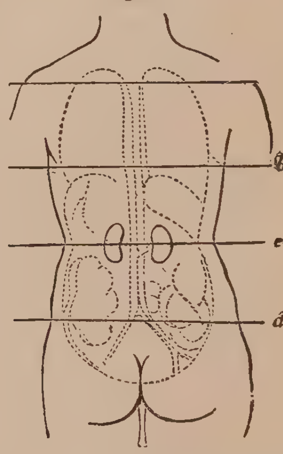


Fig. 41.



four lateral regions, taken in the same order, are the right and left hypochondriac, and the right and left iliac. The portion of the abdomen immediately above the line of Poupart's ligament is commonly known as the inguinal region.

634. The organs situate in each of these regions are as follows: The *epigastric* contains the middle portion of the stomach and the pylorus, the left lobe of the liver, the lobulus Spigelii and hepatic vessels, and the head of the pancreas: and behind these, the cœliac axis, the semilunar ganglion, and part of the vena cava, aorta, vena azygos, and thoracic duct. The *umbilical* contains the omentum and mesentery, the transverse portions of the duodenum and colon, and some convolutions of the jejunum. The *hypogastric* is occupied by the bladder and part of the small intestines. Behind the bladder is the uterus in the female, and the rectum in the male. The

right hypochondriac contains the right lobe of the liver and the gall-bladder, part of the duodenum and ascending colon, renal capsule, and part of the right kidney; the *left* contains the large end of the stomach, the narrow extremity of the pancreas, the spleen, part of the colon, renal capsule, and upper part of the left kidney. The *right iliac* region contains the cæcum, the termination of the ileum and the commencement of the colon; the *left*, the sigmoid flexure and part of the descending colon.

635. The posterior regions, formed by continuing the horizontal lines *b b*, *c c*, and *d d*, are divided by a vertical line following the course of the spine into the four regions, the right and left dorsal, and the right and left lumbar. The *right and left dorsal* contain the upper portions of the kidneys.

The *right lumbar* contains the cæcum and lower part of the right kidney; the *left*, the sigmoid flexure of the colon, and lower portion of the left kidney.

636. When any of the organs are distended or enlarged, they encroach on surrounding parts, and occupy adjoining regions. Thus, the distended stomach or bladder may encroach on the umbilical region; the distended colon may rise into the epigastric; and the enlarged liver or spleen may descend into the right or left iliac.

637. The *size and shape* of the abdomen vary with age and sex. In the child the abdomen is large; in the spare adult, small; in the female it presents an enlargement in the hypogastric region. It varies in size, in the same person, with the full or empty state of the stomach, the quantity of gas in the intestines, and of urine in the bladder. Pregnancy, ascites, ovarian dropsy, tympanites, hydatids, enlargement of the liver or spleen, and various morbid growths attached to the several organs, may also increase the size and alter the shape of the abdomen.

638. In examining the abdomen, we employ three methods—*inspection*, *manual examination*, and *percussion*. In certain cases we resort to measurement, and in a few instances to auscultation.

639. By *inspection* we ascertain the size, form, and movements of the abdomen. The size is increased by any of the causes just specified; and the form is altered, either throughout the entire cavity, or in parts, according as the cause is extensive or limited. The history of changes of form is very important. Thus, the gradual, uniform, and central enlargement of pregnancy, the lateral enlargement in the first stage of ovarian dropsy, and the equal and gradual growth of ascites, form important means of diagnosis.

640. The movements of the abdominal parietes afford important indications, especially those of respiration. Thus, in peritoneal inflammation, as well as in painful affections of the abdominal muscles, respiration is performed by the chest alone. On the other hand, in pleurisy and in painful states of the muscles of the chest or of the diaphragm, the respiration is performed chiefly by the muscles of the abdomen. Again, when the abdomen is greatly distended, the action of its muscles is nearly suspended, and

respiration is performed by the chest and diaphragm. In extreme cases, the viscera are pressed against the diaphragm, and respiration is performed solely by the muscles of the chest.

641. By the *touch*, we gain further information as to the size, form, shape, tension, and movements of the abdomen, including those of respiration. The pulsations of the aorta are also perceptible to the touch in thin persons with lax abdominal walls, in cases of aneurism, of tumors situate over it, and of accumulations of fæces. We also ascertain by the touch the temperature and sensibility of the abdomen. The *temperature* should be compared with that of other parts. In acute peritonitis, and in severe febrile affections accompanied with abdominal inflammation, the surface has a peculiar pungent heat.

642. In testing the *sensibility* of the abdomen, pressure should first be made gently, and with the open hand. If this give pain, and there is inflammatory fever, the peritoneum is inflamed; but if there is no fever, the pain may be inferred to be in the muscular walls of the abdomen. If a slight touch produces no pain, we apply a deep and moderately strong pressure; and if this occasions rather a feeling of soreness than of acute pain, we may infer the presence of inflammation of the mucous membrane of the stomach or intestines. The pain due to inflammation of the peritoneum is best developed by a lateral pressure, causing it to slide over the intestines. In colic, strong pressure relieves pain, and forms an important means of diagnosis. Muscular pain, also, is relieved by gentle pressure, gradually increased; but on the sudden removal of the hand, the muscles are thrown into action, attended by acute suffering. Muscular pain, too, is rarely accompanied by constitutional disturbance, and, like neuralgia of the skin, is often dependent on, or associated with, an irritable state of the spinal cord. The contraction of the muscles in the act of expiration is another cause of pain which must be distinguished from the effect of pressure.

643. In applying pressure to the abdomen, we should always mark the expression of the countenance, as this is much more to be depended on than the patient's answers, especially when typhous symptoms are present, or the brain is affected. When the abdomen is very tender, the patient will throw the muscles into rigid tension, so as to shield its contents from pressure; and we have to suspend our examination till the patient's attention is diverted. When the tenderness is in the right hypochondriac region, and the cause disease of the liver, the right rectus muscle is generally found in a state of rigid contraction.

644. If, in examining the abdomen, we discover a tumor, or are anxious to ascertain the state of any of its contents more exactly, we relax the muscles by placing the patient on the back, with the head slightly raised and bent forward, the arms extended by the sides, the thighs bent nearly at right angles on the trunk, the knees apart and turned outward, and the feet resting on the bed in contact with each other. The patient must also be directed to use as little muscular effort as possible, and his atten-

tion must be diverted from the examination which is going on. In this relaxed state of the abdominal walls, the size and position of tumors, and the dimensions of the viscera, are readily ascertained. In women, a combination of abdominal swelling and tension with extreme tenderness is sometimes met with, under the name of *phantom tumors.* The pain or pressure is so great as to prevent a complete examination ; but by the use of chloroform the pain ceases, the abdominal walls become supple, and the work of examination is rendered easy.

645. *Percussion* may be performed with the points of the fingers, or by the intervention of a plate of ivory or wood, or of a finger of the left hand. Applied in this latter manner over the site of the stomach, or over any part of the small or large intestines containing air, it elicits a clear sound. In the epigastric region, in ordinary states of the stomach, and over any part of the intestines largely distended with air, the sound is tympanitic. The clear sound is somewhat modified if the air be mixed with fluid. Percussion, on the other hand, elicits a dull sound when applied over solid viscera, over collections of fluid, over hollow viscera in their contracted state, over the intestines when containing only fæces, over the enlarged liver or spleen, and over solid tumors.

646. Percussion and the touch are employed together in detecting the presence of fluid. This is best done in the upright posture. The palm of one hand is placed on one side of the abdomen with a firm but gentle pressure, while the fingers of the other hand tap lightly and quickly on the part directly opposite to it. If fluid be present, a peculiar and characteristic vibrating shock is experienced.

647. Direct percussion with the points of the fingers is used to distinguish muscular pains of the abdomen. A slight quick touch throws the muscles into action, and so causes pain. This, together with the absence of pain or firm pressure gradually applied, its recurrence on the sudden removal of the pressure, the acute pain produced by every movement of the affected muscles, and the absence of urgent constitutional symptoms, combine to distinguish muscular pains from those due to disease of deep-seated parts.

648. *Measurement* of the abdomen is sometimes resorted to. A common tape graduated to eighths of an inch answers the purpose. No precautions are necessary beyond noting whether the measure is taken during inspiration or expiration. When the abdomen is uniformly enlarged by a tumor or by fluid, and especially when successive measurements are required, the tape should be applied at the level of the umbilicus.

649. *Ascultation* is occasionally resorted to in examining the abdomen, to confirm by means of the friction-sound, the diagnosis of peritoneal inflammation. This sound is caused by the rubbing together of two surfaces roughened by deposits of lymph. By using the stethoscope, we may also hear the pulsations of the aorta in spare persons, and may detect the placental murmur and the pulsations of the fœtal heart. The first is a blowing sound, synchronous with the pulse of the mother, and best heard in

the iliac regions near the groins. The second is not unlike the ticking of a watch, occurring from 120 to 160 times in a minute, and best heard about the centre of the left iliac region. It is rarely audible till the end of the fifth month.

650. In taking notes of cases of abdominal tumors or enlargement of viscera, their size and extent, as indicated by percussion, may be conveniently figured on outlines kept for the purpose. The figures annexed will serve to illustrate the use of such outlines. Fig. 42 shows the regions of dull and clear sound in the healthy subject, in which *a* shows the dull region of the liver, and *b* that of the spleen; while *c* indicates the region of clear sound over the stomach moderately distended, and *d* that of the

Fig. 42.

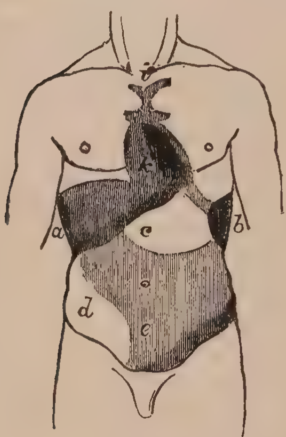
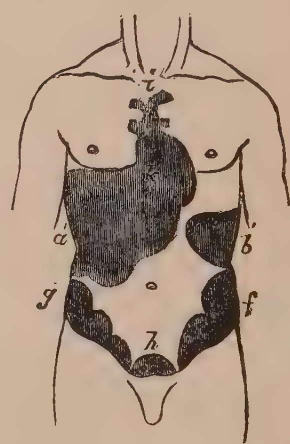


Fig. 43.



colon similarly distended. The fainter shadow (*e*) indicates the parts of the abdomen which, when empty, yield a moderately dull sound, when filled with flatus a clear (tympanitic) sound, and when filled with solid matters (as with fæces) a full dull sound. Fig. 43 shows the dull region of the liver (*a′*) extended, as in organic disease, with enlargement; (*b′*) a similar enlargement of the spleen, and the regions of dulness, corresponding with a distended descending colon and rectum (*f*); a loaded cæcum (*g*); and a distended bladder (*h*). The use of the shaded outlines, as applied to the heart and lungs, will be noticed in another place.

3. The Chest and the Organs of Respiration and Circulation.

651. An examination of the external conformation of the chest must precede all inquiries into the diseases of the parts contained within it. To facilitate such examination, the chest, like the abdomen, is divided into regions, by lines drawn from fixed points. (See Figs. p. 132.) The two horizontal lines (*a a* in the line of the clavicles, and *b b* on the level of the

ensiform cartilage), joined by a vertical line bisecting the sternum, divide each side of the chest in front into two principal regions designated by characteristic names. Those corresponding to the first horizontal line are the *clavicutar;* those above the clavicles are the *supra-claviculars;* those beneath them the *intra-clavicular.* The parts marked by the nipples are known as the *mammary* regions, and the armpits as the *axillary* regions.

On the back of the chest the *supra-scapular*, the *scapular*, *inter-scapular*, and *infra-scapular*, correspond—the first to the root of the neck and shoulders behind, limited below by the upper border of the blade-bone, the second to the blade-bone itself, the third to the space between the two blade-bones, and the fourth to that part of the chest immediately below the angles of those bones.

652. The size, shape, and movements of the chest may be ascertained by *inspection*, *manual examination*, and *measurement.*

Inspection.—A well-formed chest is large in all its dimensions, and round in its outlines. The spine is straight, or, in very strong men, and those who use the right arm much, curved almost imperceptibly toward the right. The chest appears symmetrical; but when measured, the right side is found larger than the left by about half an inch; and there is naturally somewhat more fulness above and immediately beneath the clavicle on the left than on the right side, on account of the greater prominence of the right clavicle. The chest is wider and longer in men, but deeper in women. Women are also more subject to distortions of the chest and spine.

653. A glance at the chest enables us to judge of its size. Closer examination is required to detect deviations from its usual form. The chief distortions affecting both sides alike, are those arising from constrained posture and the use of stays. Of the former, the most remarkable is the flattened chest of the shoemaker. Alterations in the shape of both sides of the chest also arise from diseases affecting equally both lungs; such as tubercle, leading to contraction, especially in the subclavian region, and dilatation of the pulmonary cells (emphysema), causing a notable convexity of the front of the chest. Alterations in the shape of a side, or of a limited portion of a side, may arise from more than one disease of the corresponding lung. Acute pleurisy causes enlargement of the affected side, but in certain chronic cases there is contraction. In hydrothorax, also, and in pneumothorax, the affected side is enlarged. In extreme cases the intercostal spaces are raised to a level with the ribs. More partial changes arise from circumscribed pleurisy and limited adhesions. In advanced phthisis, the position of a cavity is often indicated by the falling in of one of the intercostal spaces. Other changes in the size and shape of the chest arise from diseases of the heart and large vessels.

654. Inspection also enables us to ascertain the character of the respiration; whether tranquil or hurried, easy or difficult; abdominal as in acute pleurisy or acute pleurodyne; or thoracic, as in acute diseases of the abdomen and severe rheumatism of the abdominal muscles or dia-

phragm. The character of the heart's impulse may also be ascertained by inspection.

655. *Manual Examination.*—By this, as by inspection, we ascertain the development of the muscles, the thickness of the walls of the chest, the presence of œdema or emphysema of the integuments, heat and soreness of the skin, local tenderness, or muscular pain. The extent and character of the heart's impulses may also be ascertained by the hand, and it is usual to apply the two hands to corresponding parts of the chest when we wish to compare the respiration on the two sides.

656. Firm pressure in the intercostal spaces often causes pain when the pleura is inflamed, either generally or partially. This partial tenderness occurs in consumption, when the pleura covering a cavity is inflamed, or when a collection of pus is making its way externally.

657. The chest is a common seat of muscular pains. Pain in the side (pleurodyne) is a consequence of violent efforts in coughing; and pain in the left side a very frequent occurrence in weak and delicate females. These muscular pains, which are apt to be mistaken for pleurisy, are developed by slight percussion with the points of the fingers, by the movements of the arms or trunk, and by a deep inspiration. The absence of pain on firm and gradual pressure, with its recurrence when the support is suddenly removed, is also a good diagnostic of muscular pain. Percussion with the fingers throws the muscles visibly into action through the whole length of their fibres, and causes remarkable partial and transverse contractions, which are best seen in emaciated persons, and especially in advanced phthisis.

658. *Measurement.*—This may have to be resorted to in disease as a means of diagnosis; in health as a measure of strength and vigor.

In disease we may wish to acertain the size of the chest, or of certain portions of it, or to determine the degree of expansion and enlargement which the whole, or parts of it, undergo during inspiration. The progressive enlargement or diminution in its size which accompanies certain forms of disease, may also be ascertained by repeated measurements made with great care, in the same position, and in the same state of the cavity. A graduated tape may be used for this purpose. To measure the size of the chest the tape should be carried horizontally round it, passing over the two nipples, or at an equal distance above or below them. When the expansion due to the movements of inspiration is to be ascertained, one end of the tape should be firmly held by one hand to the spine, while the other is allowed to slide freely through the other held over the centre of the sternum. The chest should first be measured after a full expiration, then after a deep inspiration; by shifting the tape we may measure the degree of expansion of both sides. In making these measurements, the fact that the right side is naturally larger than the left by half an inch, must be borne in mind. The expansion of the chest in ordinary inspiration does not exceed an inch and a half, and it is somewhat greater on the right than on the left side.

659. In examining the chest with a view to test the strength and vigor of healthy persons, as in recruiting for the army, we must be provided with certain standards of comparison, and also make allowance for the different degrees in which the muscles are developed, and covered with fat. In these examinations the expansion of the chest should be performed with evident ease and freedom; and the tape drawn tightly across the nipples should show a movement of not less than an inch.

660. The greatest circumference of the chest in robust men varies from 39 to 42 inches; and in spare men of medium height ought not to fall much short of 35 inches. In robust men it bears to the height the proportion of about 1 to 1.75. If in a man of 5 feet 4 inches, the average circumference is taken at 38 inches, an allowance should be made of half an inch in the chest-measurement for every inch added to the stature.

Stature. Inches.	Circumference of Chest. Inches.	Stature. Inches.	Circumference of Chest. Inches.
64	38	69	40½
65	38½	70	41
66	39	71	41½
67	39½	72	42
68	40	73	42½

661. It ought, however, to be understood, that the chests of very tall men are not so large in proportion to their height as those of men of medium stature; tall men do not bear fatigue so well as those of shorter stature.

662. Various stethometers, or instruments for measuring inspirations, have been invented. Dr. Quain's consist of a string passing round the chest, adjusted in the act of expiration, and as the chest expands by inspiration, it indicates the enlargement by a hand moving on a dial-plate. Dr. Sibson employed a similar instrument, especially for measuring the movements of particular portions of the chest.

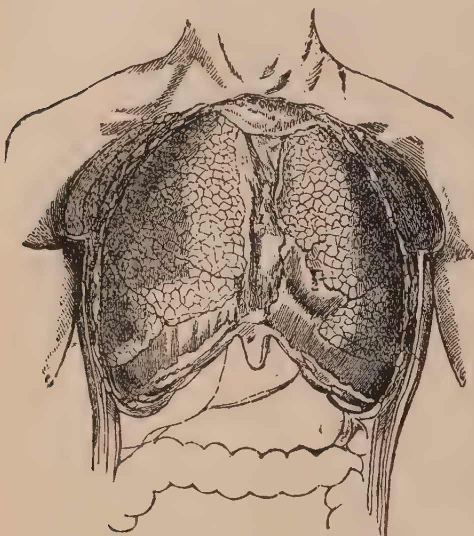
The Lungs.

663. The cavity of the chest is a hollow cone, of which the apex is cut off by a horizontal plane, corresponding with its upper opening, and the base by an oblique plane, looking forward and downward, constituting the lower opening. The first is filled by the trachea, œsophagus, and large blood-vessels; the second is closed by the diaphragm. This conical cavity is flattened before where the cartilages of the ribs join the sternum, and behind, where the ribs unite with the spine; but rounded at the sides where it is formed by the ribs and their cartilages.

664. The principal organs contained within the chest are the lungs and the heart. The size of the chest corresponds closely with that of the lungs, and is liable to various deformities from diseases affecting those organs. The size and shape of the chest are also altered in certain diseases of the heart and large vessels.

665. The lungs are in close contact with the walls of the chest in every part, with the exception of a small space (2, Fig. 44) to the left of the sternum, where they leave part of the middle mediastinum containing the heart uncovered, and a narrow space (1) behind the sternum corresponding to the position of the large vessels.

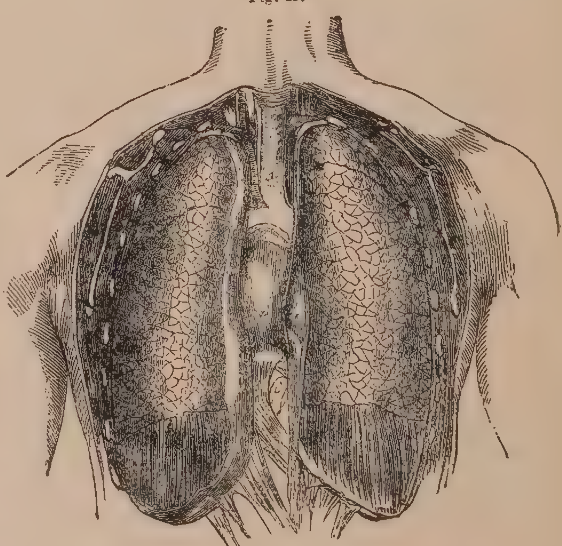
Fig. 44.



666. The apices of the lungs are contained in the supra-clavicular regions, rising from $1\frac{1}{2}$ to 2 inches above the clavicles.

667. Of the two lungs the right is the larger, but the left the longer. The right lung reaches to the level of the sixth rib in front, of the eighth rib at the side, and still lower behind. The left lung extends to the level of the seventh rib in front, it reaches the eighth rib at the side, and descends still lower behind. Both lungs applying themselves closely to the diaphragm, descend much lower behind than before, being there prolonged into thin wedges. The diaphragm separates them from the liver on the right side, from the stomach in the centre, and from the spleen and colon on the left side posteriorly. (Figs. 44, 45, and 46.) The weight of the right lung averages 22 ounces, that of the left 20.

Fig. 45.



The right bronchus enters the lung on a line with the second intercostal space, and is wider, more horizontal, and more superficial than the left.

668. The chest is subjected to several kinds of examination, having

special reference to the condition and functions of the lungs; our object being to ascertain, 1, The number and character of the respirations; 2, The capacity of the lungs; and, 3, The true condition of their texture.

669. *Number and Character of the Respirations.*—We may count the respirations in one of two ways: by observing the motions of the trunk or of some article of clothing which moves as it moves, or by placing the hand on the chest or abdomen. The first method is best adapted to the sitting or erect, the last to the recumbent, posture. The most convenient plan is to cause the patient to lie down, to rest the hand on the abdomen, and then to grasp the wrist as if feeling the pulse. But whether we count the respirations by sight or by touch, the patient's attention, should be withdrawn from the breathing, as the muscles of respiration are partially under the control of the will. The character of the respirations, whether natural, slow or quick, easy or labored, sighing, catching, or gasping, may be ascertained in either of these ways.

Fig. 46.

670. The character of the respiratory movements differs in the two sexes, and at different ages. In very young children they are performed chiefly by the abdomen; in adults of both sexes mainly by the chest. In men the lower part of the chest, in women the upper part, is brought mostly into play, both in easy and in difficult breathing.

671. In very tranquil breathing inspiration is performed by the descent of the diaphragm, marked by a gradual protrusion of the abdomen; and expiration by contraction of the abdominal walls. In ordinary breathing, however, the ribs are raised and tilted outward during inspiration, to recover themselves by their own elastic reaction during expiration. In violent inspiration, not only the diaphragm and intercostals are called into play, but the scapulæ are raised and fixed. In violent expiration, as in coughing and sneezing, the abdominal muscles are brought into action, by which the viscera of the abdomen are compressed and the diaphragm forced upward into the chest. Yawning and sighing are forms of deep inspiration; coughing and sneezing of violent expiration. Deep inspirations relieve the circulation by leaving greater space for the admission of blood into the heart, whilst violent expirations free the lungs, nostrils, and air-passages from irritating substances.

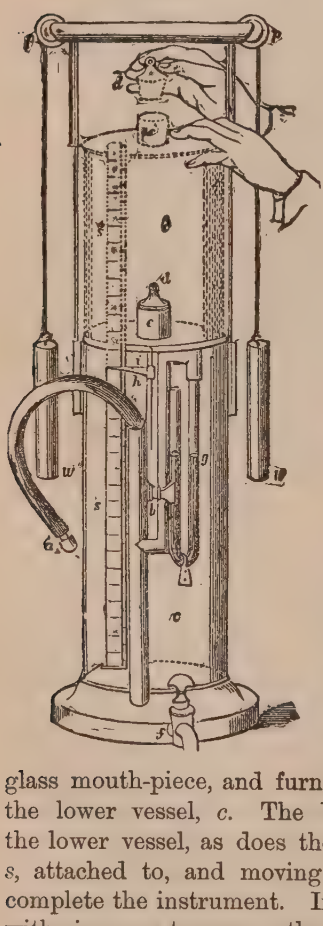
672. *Number of Respirations.*—These may be registered by an appropriate instrument. That which I devised resembles a large watch with a dial-plate graduated to 10,000 and furnished with two hands, one of which

is set in motion by a string attached to a short chain. The instrument is fastened over the pit of the stomach by a band passing round the abdomen, and the string is made tense in the act of expiration, by fastening the free end to a fixed point at a short distance from the body. Every inspiration, accordingly, by bringing the two fixed points nearer together, relaxes the string, while every expiration tightens it and sets the hand in motion, causing it to traverse one space on the dial-plate. The experiments, of which the results are given under the head of THE RESPIRATION, were performed by means of this instrument. (G.)

673. *Capacity of the Lungs.*—Several plans have been proposed for ascertaining the capacity of the lungs.

674. Dr. Lyons' method consists in noting the time required to empty the chest after a complete inspiration, by counting aloud. To render the expiration continuous and complete, the patient is directed to count from "one" upward, as far as he can, slowly and audibly; and the number of seconds is noted by the watch. The time so occupied is a measure of the capacity of the lungs. Dr. Lyons fixed its limit for perfectly healthy persons at thirty-five seconds; but this is too low; for in more than one trial I have myself continued to count for forty seconds. In confirmed phthisis, Dr. Lyons stated the limit at eight, and often at less than six seconds; and, in pleurisy and pneumonia, from four to nine. This method, though open to obvious objections, admits of useful application.

Fig. 47.



675. Dr. Hutchinson employed a gasometer properly poised and accurately adjusted.

This instrument consists of a cylindrical vessel, *c*, holding several pints of water, filled by a spout at the top, and emptied by a stopcock, *f*, at the bottom. Into this vessel a cylinder, *c*\`, of smaller size, counterpoised with the weights, *w w*, is inverted. The cover has an opening, *e*\` and *e*, in the centre, which may be closed at will by the plug, *d*\` and *d*. An elastic tube, *a*, with a glass mouth-piece, and furnished with a stopcock, *b*, communicates with the lower vessel, *c*. The bent glass tube, *g*, also communicates with the lower vessel, as does the glazed space, *i*. A graduated scale, *s*′ and *s*, attached to, and moving with, the upper vessel *c*\`, and an index, *h*, complete the instrument. If we suppose the gasometer, *c*\`, to be filled with air, so as to occupy the position indicated by the dotted lines, the in-

strument is prepared for use by taking out the plug, *d*, and lowering the gasometer till the colored spirit in the two legs of the siphon, *g*, stands at the same level. The index, *h*, is then placed at the level of the water in the glazed space, *i*, which, communicating with the reservoir, *e*, shows the height of the water within, and at the zero of the scale. The plug, *d*, is now replaced, the stop-cock, *b*, being supposed to remain closed. The subject of the experiment then fills his chest completely, and applying his mouth to the mouth-piece, and at the same time opening the stopcock, *b*, discharges the air from his lungs. The gasometer rises, the stopcock, *b*, is again turned so as to close the passage for air, the colored liquid in the siphon, *g*, is again brought to the level in the two legs, and the height of the scale above the index marks the number of cubic inches, and measures, if the experiment has been properly performed, "the quantity of air which an individual can force out of his chest by the greatest voluntary expiration, after the greatest voluntary inspiration."

676. By numerous observations made with this instrument, Dr. Hutchinson established certain averages for the healthy chest, which he then used as standards of comparison for the chests of consumptive patients. He found the limits of capacity in health to be 80 cubic inches in a dwarf measuring 3 feet 9 inches, and 464 cubic inches in a giant measuring 6 feet 11½ inches. He also ascertained that the capacity was 40 or 50 cubic inches below the mean in very fat persons; that it was reduced from 4 to 6 inches by a moderate meal, and from 9 to 14 by a full meal, that it is greatest in the erect posture; that it diminishes after 55 years of age; that it bears a remarkable relation to the stature; and that it is much diminished in pulmonary consumption.

677. The following table presents in the first column the ascertained or calculated capacity of the lungs in healthy persons between the ages of 15 and 55, of different statures, from 5 to 6 feet; and in the second and third columns the capacity of the lungs of persons of the same stature, suffering from the early and advanced stages of pulmonary consumption. (The table is taken from Dr. Hutchinson's work on the Spirometer.)

Stature. Feet.	Inches.	*Capacity. Healthy Males.* Cubic Inches.	*Early Stage of Consumption.* Cubic Inches.	*Advanced Stage of Consumption.* Cubic Inches.
5	1	174	117	82
5	2	182	122	86
5	3	190	127	89
5	4	198	133	93
5	5	206	138	97
5	6	214	143	100
5	7	222	149	104
5	8	230	154	108
5	9	238	159	112
5	10	246	165	116
5	11	254	170	119
6	0	262	176	123

678. The disparity between the capacity of the lungs in healthy persons, and in persons of the same stature under incipient and advanced consumption, is so considerable as to prove the utility of this instrument. But it must be borne in mind that emphysema and bronchitis, as well as diseases of the heart encroaching on the lungs, would give rise to the same results. In making practical application of the figures it would probably be unsafe to set down to the account of disease a moderate diminution of capacity; though Dr. Hutchinson thought that if a man between 5 feet 7 and 5 feet 8 inches, who ought to expel about 220 cubic inches of air, can expel no more than 185, or a 6-foot man, who ought to expel about 260 cubic inches, no more than 200 or 220 cubic inches, disease may be suspected. When we bear in mind the modifications in the capacity of the lungs due to the causes specified in § 691, and especially that, according to Dr. Hutchinson's statement, "very fat men, of any stature, may blow 40 or 50 cubic inches less than the mean, and yet not be diseased in the chest," it is reasonable to suppose that other causes compatible with health may lessen its capacity. The figures in the second column are, however, so much below those belonging to the healthy chest, as to furnish a very strong presumption of disease.

679. In using Dr. Hutchinson's instrument, the patient should be in the erect posture, and be narrowly watched to see that he performs the operation of expanding his chest and expelling the air carefully and properly. Allowance must also be made for advance in age above 55.

680. *The Texture of the Lungs.*—To ascertain the state of the texture of the lungs, we use the two methods known as *percussion* and *auscultation.* In percussion the air discriminates the variations of sound elicited by striking the walls of the chest; and in auscultation those caused by the passage of the air into and out of the lungs in the act of breathing, and also those which, in morbid states, are produced by the movements between the lungs and walls of the chest.

681. *Percussion.*—If the chest were full of air, it would yield, when struck, a sound like that of an empty barrel or drum; if, on the contrary, it were filled with solid animal substance, it would sound as dull as the arm or thigh. But containing, as it does, a spongy organ, the lung, including in its tissue a large quantity of air, it is less resonant when struck than if it contained only air. The more air it contains, the more resonant it is; hence it is more resonant during inspiration than during expiration. If, again, the texture of the lung be so altered as to admit a larger quantity of air, as in emphysema, the chest yields a clearer sound. On the other hand, if the lung admits less air than usual, the sound is duller. This happens in congestion, in inflammation, in tubercular deposit; when solid tumors form in the lung itself, or occupy its place; as also when the lung is compressed by fluids in the sac of the pleura (hydrothorax and empyema). But if, instead of fluid, there is air in the cavity of the pleura (pneumothorax), the sound is more hollow than if the healthy lung were in contact with the walls of the chest.

682. But the nature of the sound is also influenced by the thickness of the walls of the chest itself. If two chests contain exactly the same quantity of air, that will give the clearest sound which has the thinnest walls. Those parts, too, which are padded with muscle or fat, yield a duller sound than those which are less covered. Thus, the sound is dull over the pectoral muscles and over the shoulders; but clear above and below the clavicles, in the arm-pits, and below the angles of the scapulæ. In the healthy chest, then, the clearness of the sound will vary directly as the quantity of lung beneath the part struck, and inversely as the thickness of the walls.

683. Again, wherever the substance of the lung is thin, the sound on percussion is modified by the parts lying immediately behind it: thus, below the fourth rib, the layer of lung in front of the liver on the right side is thin; and the sound is less clear than in the upper part of the chest. The thin layer of lung which overlays the heart, so as to leave only a small portion of it uncovered (2, Fig. 44), has the same effect. In all such cases, gentle percussion elicits the clear sound of the healthy lung, strong percussion that of the solid substance behind it. The limits of the clear sound are somewhat extended by a deep inspiration, which stretches and expands the lungs; and diminished by a forcible expiration, which contracts them. Tumors in the deeper-seated parts of the lung, or consolidation of the lung itself, have the same effect as a solid viscus. Gentle percussion elicits the clear sound of the healthy lung, and strong percussion the dull sound of the tumor or condensed lung beneath. The clearer sound of the healthy lung is exaggerated in the parts of the chest near the stomach by the air which it contains.

684. When the chest is being examined, the patient should be in the erect or sitting posture, and, if possible, in an open room, for curtains and bed-clothes dull the sound. The chest should be bare, or only covered by a single layer of clothing. Each part under examination should be rendered as tense as possible; the anterior part by stretching the neck and throwing back the shoulders; the supraclavicular space by turning the neck to the opposite side; the axillæ, by raising the arms above the head; and the back part by causing the patient to fold his arms and stoop. In comparing opposite and corresponding points, the position of both sides must be the same. If we are examining the front of the chest, the hands must fall loosely; if the sides, they must be raised equally above the head; if the back, they must be equally folded.

685. There are different ways of eliciting the sounds of the chest by percussion. We may strike with the points of the fingers, the flat of the hand, or the fist; or we may interpose the fingers of the opposite hand, a pad of india-rubber, or a plate of wood or ivory. Such things are called "plessimeters," and percussion by their aid is named "mediate percussion." When dealing with slight differences of sound, a plessimeter combined with a hammer may be so used as always to strike with the same force. Dr. Sibson made use of this combination under the name of a

"spring plessimeter," consisting of a round pad of india-rubber fixed to the end of an axis, and striking on a plate of ivory. The axis works through a collar, and, being raised, is made to fall each time with equal force by means of elastic springs.

686. Direct percussion with the points of the fingers should only be employed to set the muscles in action, for in many cases, especially in advanced phthisis pulmonalis, the skin and muscles are so sensitive that the slightest touch occasions pain. Percussion with the open hand, or closed fist, is little used, except when we wish to contrast the two sides of the chest over their whole extent at once.

687. Mediate percussion is always to be preferred, and the readiest plessimeter is a finger of the left hand applied to the surface with a firm pressure, by which the skin and flesh are condensed, and made better conductors of sound. This is especially necessary in stout, flabby, dropsical, or emphysematous subjects. The finger should then be sharply struck by the three middle fingers of the right hand, taking care that the stroke falls directly and not obliquely. In comparing the two sides of the chest, care should be taken to strike the same point, with the same force, and in the same state of the chest, whether full of air in inspiration, or partly emptied by expiration, or motionless as when the breath is held.

688. The chief indications given by percussion in disease, by clear and dull sounds respectively, are shown in the following table :

	In the Lungs.	*External to the Lungs.*
Resonant or clear.	Healthy condition.	
Hyper-resonant Tympanitic Amphoric	Emphysema. Tubercular excavation.	Very thin chest-walls. Pneumothorax.
Dull sound on percussion.	Congestion, hepatization, and condensation. Pulmonary apoplexy. Œdema. Tubercular deposit. Other morbid degenerations.	Pleuritic effusion. Hydrothorax. Hæmothorax. Tumors in pleura or mediastinum. Diseases of heart or arteries, with enlargement.

689. From the part of the chest in which the clear or dull sound occurs, we may often infer the cause which produces it. Thus, emphysema, though it may be confined to one side, and to a limited spot, commonly occurs on both sides, and over a large extent of lung; pneumothorax, on the contrary, is usually confined to one side, and tubercular excavations generally to the upper part of the lungs. Congestion and hepatization occupy chiefly the lower lobes, generally on one side, but sometimes on both; œdema commonly exists in both lungs at the same time, tubercular deposit is found chiefly in the upper lobes; whilst other morbid degenerations occupy all parts of the lungs indifferently. Of causes external to the lungs, effusion of serum, blood or pus into the cavity of the pleura is commonly confined to one side; tumors in the pleura and mediastina may occupy any position; diseases of the heart affect the

neighboring parts; and aneurismal tumors chiefly the upper and anterior part of the chest.

690. *Auscultation.*—The passage of air through the structures of the lungs, in inspiration and expiration, causes certain sounds, which are heard on applying the ear or the stethoscope to the chest, and are found to vary in different situations. In the neck, and at the upper part of the sternum during inspiration, a hollow, blowing sound is heard—this is tracheal respiration; on each side of the upper part of the sternum, between the scapulæ, and sometimes in the axillæ, a whiffing tubular sound—this is bronchial respiration; on most other parts of the chest a sound which has been compared to that of a sleeper breathing gently through the nostrils, or to the sighing of a gentle breeze—this is called vesicular, from its presumed seat, the air-cells. This sound is heard both in inspiration and expiration; but the expiratory murmur is usually almost inaudible or very faint. When this breezy murmur is very distinct, as in children, it is termed *puerile respiration.*

691. The intensity of this respiratory murmur varies in different healthy persons, and in the same person at different times. It is more intense, as has just been stated, in young children and in females. It is also augmented by deep inspiration, and, therefore, may be increased by causing the patient to breathe quick, to draw a deep breath, or to cough, whereby the lungs are emptied, and a full inspiration secured. The respiratory murmur also becomes more intense, or *puerile*, in one part of the lung by consolidation of the remainder, and in one lung by consolidation of the other; also by partial impediments to free action of the lung, such as tight stays.

692. The respiratory murmur is sometimes scarcely audible; but in the absence of other morbid sounds, and of dulness on percussion, this indistinctness does not indicate disease.

693. The respiratory murmur may also be absent in limited portions of the chest, through the bronchial tubes being obstructed by tenacious mucus; but here percussion will give a clear sound. When the air-cells are filled with fluid from within, or compressed from without, the chest will sound dull on percussion, unless the pressure be occasioned by air in the pleura.

694. The *bronchial* respiration in health is heard along the track of the large bronchial tubes; but if the lung be condensed, it not only loses its proper respiratory murmur, but, being a better conductor, conveys to the ear the sound produced in the tubes. Hence bronchial respiration heard with unusual distinctness near the site of these tubes, or heard on one side and not on the other, or with widely differing intensity on the two sides, or in parts where it is not heard in health, is an indication of consolidation by disease or pressure.

695. The bronchial respiration, as thus heard, resembles intense puerile respiration; or the noise made by drawing the breath through the closed hand; or that occasioned by blowing into a quill; or, lastly, the short puff used in blowing out a candle.

696. To the same class of sounds belongs the *cavernous* respiration, which, in its most marked form, produces the illusion that air is drawn through the stethoscope in inspiration, and puffed into the ear in expiration. It generally arises from a cavity in the substance of the lung—but occasionally from a dilated bronchus.

697. The *amphoric* respiration is a sound like that produced by blowing into a bottle, and is caused by the passage of air into or out of a cavity in condensed lung tissue.

698. Besides the respiratory sounds produced in the tubes and air-cells of the lungs, when those parts are moistened by their natural secretions in their usual quantity, there are other sounds due to the increased resistance offered to the passage of air by constriction of the parts themselves, or by fluids of various degrees of consistence.

699. The variation in character and intensity of these sounds is indicated by the terms *râle* (rattling), *rhonchus* (snoring), *crepitation* (crackling), and *sibilus* (hissing, wheezing, or whistling). *Crepitation* is further distinguished as *dry* and *moist*—the dry being due to swollen mucous membrane, constriction of the tubes, or obstruction with viscid phlegm ; the moist to fluids of less consistence in the tubes or cells.

700. *Râles* are limited to the larynx, trachea, and bronchial tubes ; *Rhonchus* and *Sibilus* to the largest and medium-sized tubes ; and *Crepitation* to the fine air-tubes and the air-cells.

701. *Crepitation* is of two kinds—*fine* and *coarse.* Fine crepitation has its seat in the air-cells and smallest air-tubes ; it is a very delicate sound, resembling that caused by rolling a lock of hair between the thumb and finger. Coarse crepitation is heard in the finer and medium-sized tubes, and is nothing more than fine mucous râle.

702. Crepitation is further subdivided into *moist* and *dry*. *Moist* crepitation (*râle crepitant* of Laennec) is a rapid succession of crackles, such as are produced by throwing salt on a hot iron plate. The sensation may be *felt* by compressing healthy lung tissue or emphysematous integument. It exists whenever the finer bronchi and air-cells, partially filled with viscid fluid, still admit the passage of air. Hence it is present in œdema and apoplexy of the lungs ; occasionally in pulmonary catarrh and bronchitis ; often in the first stage of phthisis ; and in the first stage of pneumonia, as its most constant and characteristic sign. It disappears when hepatization comes on, and reappears when the inflammation is subsiding. In the first and last of these stages the moist crepitant rhonchus obscures the respiratory sound, but does not completely mask it : in the stage of hepatization, both sounds are absent.

703. *Dry* crepitation. (*Râle crepitant sec à grosses Bulles*, or *craquement* of Laennec.)—This is the sound produced by blowing into a dry bladder. It occurs during inspiration in emphysema, and most distinctly in interlobular emphysema.

704. *Rhonchus* and *Sibilus.*—These sounds indicate a dry state of the mucous membrane. They generally occur together as *sibilant rhonchus*

which resembles a prolonged whistle, the chirping of birds, or the sound emitted on the separation of two smooth oiled surfaces. The *sonorous* resembles the snore of sleep, the bass note of a violoncello or the cooing of a pigeon. When intense it may be perceived by the hand placed on the chest. All these varieties of sound arise from contraction of a portion of bronchial tube, by swelling of the mucous membrane, by pressure of consolidated lung, or by a plug of tenacious mucus; the sibilant rhonchus existing in the smaller, and the sonorous in the larger tubes. A *click* is also sometimes heard, either during inspiration or expiration, from the sudden displacement of viscid mucus.

705. The *moist* bronchial rhonchus is called the *mucous râle* (*râle muqueux* of Laennec). It is due to the passage of air through tubes containing a fluid, as when we blow through a pipe into soap and water. It is present in pulmonary catarrh, bronchitis, and hæmoptysis; and in all diseases accompanied with much expectoration, as in the third stage of pneumonia, and in phthisis. The *tracheal* râle is a modification of this sound, existing in the trachea when filled with fluid. It has been compared by Laennec to the rolling of a distant drum, or the noise of a carriage in a paved street. The *cavernous rhonchus* is extremely rare. It is caused by the bubbling or gurgling of a fluid in a *circumscribed* space, and is, therefore, a sure sign of a cavity in the lungs, which, in ninety-nine cases out of a hundred, is of tuberculous origin.

706. *Vocal Sounds.*—In a healthy chest there is commonly a diffused resonance, most distinct between the scapulæ, in the situation of the bronchial tubes. If we rest the hand on the chest in the act of speaking, especially if the voice be a bass, we perceive a vibration, or *fremitus.* If we place the stethoscope over the larynx or trachea, the voice seems to pass through the tube, being much more clearly perceived by the ear applied to the stethoscope than by the other. This is *laryngophony.* A similar sound is heard when the lungs between the bronchial tubes and the walls of the chest are condensed, and especially if the bronchi are at the same time enlarged. This is *bronchophony.* If in the cavity of the pleura, outside a condensed lung, there is a thin layer of fluid, as happens in recent cases of pleurisy, a sound is heard like the bleating of a goat, or the squeaking of Punch. This is *œgophony.* Again, in cases of pulmonary excavation, the voice passes through the tube to the ear, as it does in laryngophony, and is called *pectoriloquy.* Lastly, when there is a large cavity communicating with the bronchi, containing fluid and filled with air, a sound is produced during respiration, by speaking or in coughing, which resembles the falling of a pin into a cup; or the expiratory sound is exaggerated and resembles the faint vibration of a metallic tube. The first is called *metallic tinkling*, the second *metallic breathing.* These sounds occur in large abscesses of the lungs, but most distinctly in pneumothorax, in very rare cases of which disease this metallic tinkling has been produced by each beat of the heart.

707. There is one sound which, though due to an external cause, may

be confounded with sounds originating within the chest—the *muscular sound* (*bruit musculaire*). It is due to muscular contraction and is very distinct in patients shivering with cold, or in whom the muscles are put on the stretch, as when the shoulders are forcibly thrown back, the hands forcibly raised above the head, or the arms strongly folded across the chest. It is an extremely rapid vibrating sound, closely resembling, when strongly marked, the distant rumbling of carriages over a paved street. The pupil should make himself familiar with it, by placing his ear on the pillow, and contracting the muscles of the jaw with different degrees of force and quickness, taking care, at the same time, to avoid grating the teeth. When he closes the jaw gently, he will hear the rapid vibration just mentioned; a stronger contraction will render the vibration more rapid; a strong and abrupt contraction closely imitates the first sound of the heart. The continuity of the "bruit musculaire" distinguishes it at once from all respiratory and vocal sounds.

708. It only remains to mention two sounds which have their source external to the lungs, in the sac of the pleura. The one is a *friction* or *to-and-fro* sound, occurring both in inspiration and expiration when the pleuræ are dry and rough with deposits; the other a *splashing* sound, distinctly heard by the ear applied to the chest, when there is a mixed collection of air and fluid in the pleural cavity, and a sudden jerk (*succussion*) is given to the chest. This sound is sometimes heard in very large tubercular cavities.

709. The young auscultator may consult with advantage the following table, which presents at one view the chief points just stated:

SOUNDS PRODUCED BY THE PASSAGE OF THE AIR IN RESPIRATION.

Natural.

Tracheal: in the neck and at the top of the sternum.
Bronchial: near the top of the sternum, and between the scapulæ.
Vesicular: on most other parts of the chest.

Morbid.

Bronchial respiration: from condensed lung.
Cavernous: / *Amphoric:* in cavities communicating with the bronchi.

Râles and Rhonch.	*Moist.*	*Mucous:*	liquid in bronchi.
		Crepitation:	viscid liquid in small tubes and air-cells.
		Gurgling:	liquid in cavity.
	Dry.	*Dry crepitation:*	in emphysema.
		Cavernous rhonchus:	in cavity destitute of fluid.
		Sibilant and *Sonorous rhonchus*	Contraction of bronchi, by swelling of mucous membrane, pressure, or tenacious secretion.

SOUNDS OF THE VOICE TRANSMITTED THROUGH THE CHEST.

Healthy.
- *Laryngophony:* over larynx.
- *Tracheophony:* over neck and upper part of sternum.
- *Bronchophony:* near top of sternum, between the scapulæ, etc.
- (*Fremitus*, or *vocal vibration:* felt by hand in many parts of chest.)

Morbid.
- *Bronchophony:* sound of voice through condensed lung.
- *Ægophony:* the same vibrating through a thin layer of fluid.
- *Pectoriloquy:* the same in a cavity of the lungs.
- *Tinkling, etc.:* a changed echo of voice or cough in a large cavity containing air and liquid.

SOUNDS PRODUCED BY THE MOTIONS OF THE LUNGS.

Friction sounds, when the pleuræ are dry or rough from deposit.

SOUND PRODUCED BY SUCCUSSION.

A splashing sound, when the cavity of the pleura or a large tubercular excavation contains fluid mixed with air.

SOUNDS PRODUCED BY THE CONTRACTION OF THE MUSCLES.

Vibratory sounds of varying intensity.

THE HEART.

710. The position of the heart and large vessels, with their relation to the walls of the chest and to the lungs, will be best understood by referring to Figs. 44 and 45. It will be seen that the lungs, which fill so large a part of the chest, leave an irregular space (1 and 2, Fig. 44) in the anterior part of the chest unoccupied. That part of this space (1) which lies behind the upper half of the sternum has a nearly uniform width of two inches, the anterior edges of the two lungs being here nearly parallel. The lower portion of this space (2), on the other hand, being formed by the wide separation of the left lung from the right, approaches the triangular form. The upper part corresponds to the large vessels, the lower to the heart. This space, however, does not represent the size and shape of the heart and large vessels, but merely of such portions of them as are not concealed from view by the thin edges of the lungs; nor can the heart and large vessels be fully seen until the pericardium has been opened, the cellular membrane connected with it dissected away, and the lungs turned aside to right and left. Posteriorly (Fig. 45), the inner edges of the two lungs are nearly parallel, leaving a centre space (1 and 2), about two inches wide, occupied by the trachea and œsophagus above,

and by the œsophagus and descending aorta below. In consequence of the great thickness of the spine and muscles of the back, this space is not favorable to stethoscopic examination.

711. The pericardium, which surrounds the heart, is firmly attached above to the large vessels connected with its base, and to the diaphragm below; so that the heart within this fibro-serous sac descends with the diaphragm in inspiration, and ascends with it in expiration.

712. The large vessels at the base of the heart form a sort of fixed point on which it moves. From this point it is tilted and twisted forward during contraction of the ventricles; toward this point it is raised with the diaphragm during expiration; and from this point it is pulled downward during inspiration. These changes of place are exaggerated by the ribs moving in directions opposite the diaphragm.

713. In tranquil breathing, the vertical movement of the heart is scarcely perceptible, but the variation of the height of the apex during full inspiration and expiration is so great, that, during a deep inspiration, the apex, instead of beating in the fifth intercostal space, may be felt in the sixth, but indistinctly, from the lung being drawn in front of it. By a forced expiration, on the other hand, the ribs are drawn down and brought closer into contact with the heart, so that it may be felt beating in the fourth intercostal space, and even as high as the third rib.

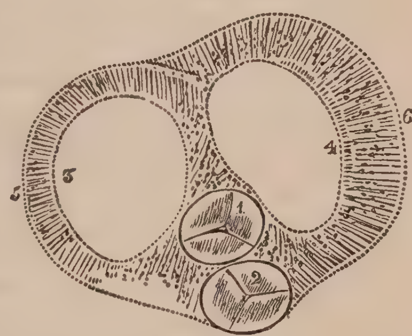
714. The same act of inspiration which depresses the diaphragm and tilts the ribs outward expands the lungs, so that their anterior edges slide over the pericardium; and the same act of expiration which forces the diaphragm upward, and pulls the ribs downward, causes the lungs to collapse and their anterior edges to slide back again, thus leaving more of the pericardium exposed. A distended stomach or a general enlargement of the abdomen has the same effect on the position of the heart as an act of expiration.

715. In consequence of the free motion which the heart enjoys, it is affected by the posture of the body, receding a little from the anterior walls of the chest when we lie on the back, and moving somewhat to the right or left as we lie on the sides.

716. The heart, then, occupies an oblique position within the chest, so that, when we stand or sit, the base, fixed by the attachments of the large vessels, is directed upward, backward, and to the right; the apex downward, forward, and to the left; the base separated from the fifth, sixth, and seventh dorsal vertebræ by the descending aorta and œsophagus; the apex, when the ventricles are contracted and the respiration tranquil, corresponding to the space between the fifth and sixth ribs—a point about one and a half inch below, and one inch to the inside of the left nipple, or two inches and a half from the left border of the base of the ensiform cartilage. One half the heart, consisting of a small part of the left auricle and the whole of the left ventricle, and the left vertical half of the right ventricle, lies to the left of the sternum, behind the cartilages of the fourth and fifth, and the sternal articulations of the fifth, sixth, and seventh ribs, and the

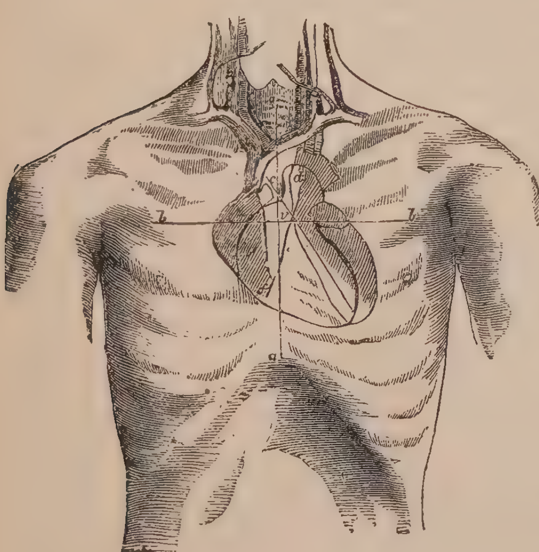
fourth, fifth, and sixth intercostal spaces: the other half of the organ, consisting of nearly all the rest of the right ventricle, lies behind the lower half of the sternum, a small part only of the ventricle and the right auricle being behind the sternal articulations of the third, fourth, and fifth ribs, and the fourth and fifth right intercostal spaces. The flat under and posterior surface of the left ventricle lies upon the diaphragm, which separates it from the left lobe of the liver; the rounded right ventricle is turned upward and forward, separated from the sternum and thin anterior edges of the lungs by the pericardium and loose cellular membrane connected with it.

Fig. 48.



717. The orifices and valves, which are the seat of the sounds heard on applying the ear or the stethoscope over the heart, are very close to each other, the orifice of the aorta (1, Fig. 48) lying directly behind that of the pulmonary artery (2), while the right and left auriculo-ventricular orifices (3 and 4) are only a third of an inch apart, and just below those of the arteries. The diagram (Fig. 48) shows, in horizontal section, both the relative positions of the semilunar valves and the relative thickness of the walls of the right (5) and left ventricle (6).

Fig. 49.



718. The position of these valves in the healthy subject, relatively to the bones and walls of the chest, has been determined by transfixing them with needles. In the recumbent posture, the bulging part of the pulmonary artery corresponds to the space between the second and third ribs of the left side, close to the sternum; so that a line (*b b*, Fig. 49) drawn across the sternum to the lower margin of the third ribs passes over the valves of the pulmonary artery, a little to the left of the mesial line (at *v*), and about half an inch above the valves of the aorta, which lie (in the erect

position of the body) behind the pulmonic valves. The auriculo-ventricular orifices correspond to a line drawn across the sternum at a somewhat lower level in the third interspace, the valves themselves being situate to the right and left of those of the aorta and pulmonary artery respectively.

719. As a knowledge of the exact relation of the heart, and of its several parts, to the bones and walls of the chest is very conducive to a sound diagnosis of its diseases, the facts already stated will be briefly recapitulated, reference being made to the engraving on previous page.

720. (1.) *Parts of the Heart and Large Vessels not covered by the Lungs, and separated from the Walls of the Chest only by the Pericardium and loose Cellular Tissue.*—The root of the pulmonary artery; the ascending aorta; the anterior surface of the right ventricle; a small portion of the appendix of the right auricle, with the apex and anterior margin of the left ventricle. (See 1 and 2, Fig. 44, and the unshaded portion of the heart in Fig. 49.)

(2.) *Pulmonary Artery.*—Close to the sternum, in the interspace of the second and third ribs of the left side.

(3.) *Aorta.*—The ascending aorta lies behind the mesial line of the sternum; it makes its first bend behind the manubrium, and is then directed obliquely backward to the left, forming the arch, the crown of which is on a level with the first intercostal space. The descending aorta commences on the left of the third dorsal vertebra.

(4.) *Valves of the Pulmonary Artery and Aorta.*—The first of these is situate immediately to the left of the intersection of a line, *b b*, drawn across the sternum to the inferior margins of the third ribs, with the mesial line, *a a*. The latter lie immediately behind those of the pulmonary artery on a level with the body of the fifth dorsal vertebra.

(5.) *Auriculo-Ventricular Valves.*—To the right and left of the valves of the aorta and pulmonary artery respectively, about a third of an inch apart, the tricuspid being somewhat lower than the mitral.

(6.) *Apex of the Heart.*—When the body is erect and the breathing tranquil, this is felt beating between the fifth and sixth ribs of the left side, an inch and a half below, and an inch to the inside, of the left nipple.

721. In examining the heart, three points demand attention—its *position and size*, its *motions*, its *sounds*.

722. *Position and Size of the Heart.*—These are determined chiefly by percussion, and in some cases, though with less accuracy, by the touch. In healthy and well-formed persons percussion elicits a dull sound over an area of about two inches in diameter, extending from the point where the heart's beat is felt to the left side of the lower half of the sternum as high as the third costal cartilage. This space, which corresponds to the part of the heart uncovered by the lungs, yields a dull sound, both on strong and slight percussion. Beyond this space the sound is gradually softened off, in proportion as the thickness of the overlapping lung increases; but on strong and sharp percussion the dull sound is heard through the intervening portion of lung. When the heart is enlarged, or the pericardium

filled with fluid, the region of dulness is increased. The same effect is produced by consolidation of the surrounding lung, by tumors between the pericardium and walls of the chest, by partial pleuritic effusions confined by false membranes, or even by enlargement of the left lobe of the liver. It is only in the ascertained absence of such diseased conditions that the extent of dulness on percussion may be taken as the measure of the heart's size. (See Figs. 42 and 43, in which the area of dulness in health and its extension in disease are compared.)

723. On the other hand, the absence of dulness on percussion does not afford certain evidence of non-enlargement of the heart; for emphysema of the lung, pneumothorax, or even distention of the stomach with gas, may give rise to so clear a sound on percussion as to mask the heart-affection. The dulness also ceases, even in healthy persons, on lying down or taking a deep breath. The persistence of a dull sound under these circumstances affords evidence either of adhesions of the heart or lungs, or of such an enlargement of the heart, or distention of the pericardium, as prevents the heart from receding.

724. *Motions and Rhythm of the Heart.*—The auricles and ventricles contract alternately, the systole of the one being synchronous with the diastole of the other. The auricles first contract, then the ventricles. The contraction of the ventricles is followed by their silent diastole, causing a short pause. During the diastole of the ventricles, and the accompanying short pause, the blood flows from the auricles into the ventricles, and the contraction of the auricular appendices, which immediately succeeds the pause, excites the ventricles to new contraction. The order, therefore (or *rhythm*), of the heart's movements is as follows: systole of ventricles and diastole of auricles; diastole of ventricles and systole of auricles; corresponding to the interval of no sound or pause. Of the *whole* time consumed, the systole of the ventricles occupies one-half; the systole of the auricles and the diastole of the ventricles with the pause the other half.

725. The *impulse* of the heart is synchronous with the contraction of the ventricles and the pulse in the large arteries. It is due to the contraction of the ventricles, which are at the same time pressed more closely against the chest-wall. The effect is felt chiefly at the apex; for a thick mass of spongy lung absorbs and neutralizes the force of the impulse over the rest of the heart's surface. A full expiration, or the bending of the body forward, by lessening the intervening portion of lung, extends the limits of the impulse.

726. The strength of the impulse, and the extent of surface over which it is felt, vary greatly in disease. When the walls are thickened at the expense of the cavities (concentric hypertrophy), the impulse is little increased in extent but greatly augmented in force; but when the walls are thin and the cavities large, the impulse is less forcible but of greater extent. If thickening of the walls is accompanied by increased size of the cavities (in which case the heart will be greatly enlarged), the impulse

is stronger and more extensive, and perceptible over a space of five or six square inches.

727. Fluid in the pericardium renders the impulse indistinct and its place variable. Adhesions of the heart and pericardium, on the contrary, confine the impulse to one spot, so that neither change of posture, nor the movements of inspiration and expiration, have any sensible effect upon it. Congenital transposition of the heart is rare. Tumors within the chest and diseases of the lungs may displace the heart and shift the spot in which the impulse is felt. This will be more distinctly felt, *cœteris paribus*, when the contraction of the ventricle is abrupt.

728. When the heart beats strongly, and especially in emaciated subjects, its movements may be seen as well as felt, and their force, extent, and nature furnish useful indications. When the heart is enlarged these movements are perceptible in the epigastric region.

729. The heart is also subject to irregularities of action; such as double and triple impulse, depending generally on spasmodic and partial contraction of the ventricles, and on irregular transmission of blood from the auricles; to intermittence, inequality, and increased or diminished force. As these produce appreciable changes in the pulse, they will be considered under that head.

730. *Sounds of the Heart.*—The natural sounds of the heart are two—a dull, prolonged sound, synchronous with the contraction of the ventricles, the heart's impulse, and the pulse in the larger arteries; and an abrupt, clear sound immediately succeeding the first, and followed by a silent interval. The first sound is loudest over the middle of the ventricles, the last over the site of the semilunar valves, and for a short distance upward along the sternum. Both sounds are most distinct when the pulse is slow, and more so in thin than in stout persons. We hear them in our own persons when lying on the left side; and in disease they may sometimes be heard at a short distance from the patient. The intensity of the sound diminishes as the distance from the præcordia increases.

731. In stout persons the sounds are limited to the region of the heart itself; in narrow-chested persons and in children they may be heard all over the chest, before as well as behind. Any cause which increases the conducting power of the contents of the chest, such as consolidation of the lungs in pneumonia and phthisis, extends the limits within which the sounds are audible. When consolidation is confined to the right side, the sounds of the heart are heard more distinctly on that side, both before and behind, than on the left.

732. *Cause of the Sounds.*—The dull, heavy, prolonged first sound is caused by the contraction of the ventricles and their *musculi papillares*, stretching the cordæ tendineæ and the membranous valves (tricuspid and bicuspid) into which they are inserted. The second sound is due to the sudden expansion and flapping together of the semilunar valves.

733. The heart-sounds may be changed in intensity or in kind. An increased loudness is often heard during nervous palpitation, both by the

patient and his attendants; it may also be produced by dilatation of the ventricles. In the former case, the impulse is increased; in the latter, diminished. On the other hand, the sounds may be so feeble as to be heard with difficulty; as happens in general debility, in obstructed pulmonary circulation, when the heart is overloaded with blood, in softening of its fibres, and in excessive hypertrophy. In the latter case, there will be strong impulse with weak sounds.

734. During nervous palpitation, and after strong exercise, both sounds of the heart are unusually distinct; the contor action being strong and abrupt, and the valves of the aorta closing with a jerk.

735. Of the sounds present in unusual or diseased conditions of the circulation, some belong to the heart, others to the blood-vessels. They are the following: The *bellows sound* (bruit de soufflet), the *simple blowing sound*, the *hissing sound*, the *sawing sound* (bruit de scie), the *rasping sound* (bruit de râpe), a *humming sound* (bruit de diable), a *buzzing sound* (bruit de mouche), a *whizzing sound*, and peculiar musical sounds, such as cooing, whistling, etc.

736. The sounds heard over the region of the heart, or in the large vessels that spring from it, are chiefly the bellows sound and its modifications—the sawing or rasping sound, and the musical sounds.

737. The *bellows* sound is always produced when there is a marked disproportion between the force of the heart's contractions and the size of the tubes or orifices through which the blood has to pass. It may arise—1. In healthy persons, during very strong contraction of the heart, the arteries retaining their normal size; in nervous persons, during violent palpitations, the heart contracting both quickly and forcibly; in chlorotic females, from, as is thought, a thin condition of the blood; and in cases of great debility from sudden hemorrhage. In these cases the sound is not constant. When present, it bears a close resemblance to the panting noise of a locomotive engine. 2. From narrowing of the orifices, the heart contracting as usual or with increased force: as when the orifice of the aorta or pulmonary artery is contracted, with or without enlargement and hypertrophy of the corresponding ventricle. 3. From narrowing of the orifices by deposits, incrustations, or thickening of the valves. 4. From adhesion of the aortic or auriculo-ventricular valves to the adjacent walls.

738. The student must be cautioned against confounding a rapid tubular respiration with a *bruit de soufflet*. When the cause of the sound is doubtful, the patient should be made to hold his breath.

The place in which abnormal sounds are heard, and the sound of the heart which they accompany, often enable us to fix on their precise seat and cause. Thus, sounds heard only in the region of the heart or over the valves, becoming indistinct when the ear follows the course of the aorta, but more distinct as the ear approaches the apex, may be ascribed to disease of the auriculo-ventricular valves; or to external causes having the pericardium for their seat. On the other hand, sounds heard in the site of the valves, and remaining equally distinct or becoming more dis-

tinct as the ear follows the course of the large vessels, may be referred to disease of the coats or valves of the aorta or pulmonary artery. Of the two auriculo-ventricular valves, the mitral is much the more liable to disease. Of the two arteries, the coats and valves of the aorta are by far the most liable to morbid change.

739. If the abnormal sounds accompany the first sound of the heart, they are probably due to disease of the auriculo-ventricular orifices, or of the valves or coats of the arteries. When they accompany the second sound, they probably arise from disease of the aortic valves. Double sounds are commonly due to disease simultaneously affecting both the auriculo-ventricular and the semilunar valves.

740. A more exact diagnosis of the causes of abnormal valvular sounds may be arrived at by taking together the position of the valves and the direction in which the sounds are most distinctly conducted. In the case of the tricuspid the valvular sound conducted by the walls of the right ventricle would be most distinctly perceived on the right side, and toward the base of the heart; while abnormal sounds due to disease of the mitral valve would be most distinctly heard on the left side, and toward the apex. So also with abnormal sounds due to disease of the two great arteries; the sounds will continue distinctly audible along the track of the respective vessels, but become less and less distinct as the ear travels in a direction from the base to the apex of the heart. Aortic murmurs, therefore, will continue distinct behind the middle of the sternum, and in the direction of the right shoulder; while pulmonic murmurs, becoming indistinct in that direction, will be best heard at the left of the sternum, between the second and third ribs, and continue distinct in the track of the left pulmonary artery, or for a short distance in the direction of the left sub-clavicular space.

741. The following diagnosis of valvular sounds is in accordance with these statements:

(1.) A murmur with the *first* sound of the heart heard over the site of the semilunar valves, and most distinct at *c* (Fig. 49, p. 153), is *aortic.*

(2.) A murmur with the *first* sound heard in the same situation, but most distinct at *d*, is *pulmonic.*

(3.) A prolonged murmur with the *second* sound, loudest over the semilunar valves, is due to regurgitation through those valves—of the aorta, if the sound is loudest in the direction *c e;* of the pulmonary artery, if loudest in the direction *d f;* but in either case becoming less intense, as the ear travels toward the apex of the heart.

(4.) A murmur with the *first* sound, loudest at *f*, is from tricuspid regurgitation.

(5.) A murmur with the *first* sound, loudest at *e*, is from mitral regurgitation.

(6.) A murmur with the *second* sound, loudest at *e*, is from contraction of the mitral; if loudest at *f*, from contraction of the tricuspid.

Lastly, as a general rule, a murmur with either sound distinct at *c* and *d* is semilunar; if distinct at *e* and *f*, it is tricuspid or mitral. And it

must be remembered that murmurs originating in the right side of the heart are extremely rare.

742. The indication afforded by abnormal sounds over the heart and large vessels may often be confirmed or corrected by placing the hand on the wrist, while the ear is applied to the chest. In the case of disease of the auriculo-ventricular valves, when the sound precedes the pulse, it has been attributed to the entry of the blood into the ventricle; but since the contraction of the auricle is too feeble to induce vibration in a stiffened valve, the so-called "præsystolic" murmur requires some other explanation. When the sound is synchronous with the pulse it is caused by reflux of the blood. The indications may also be confirmed or corrected by attending to the pulse. For instance, an irregular, unequal, and feeble pulse is common in disease of the mitral valve, but a full, hard, regular, thrilling pulse in disease of the aorta.

743. The sounds heard in the region of the heart, from causes external to it, are superficial friction sounds, generally double, and in rare cases triple or fourfold. They arise from deposits of fibrin or other morbid formations on the pericardium. They are of limited extent, and are not heard in the course of the large vessels; and they differ from endocardial sounds by their to-and-fro brushing or rubbing character; they are more superficial, and vary much in intensity, according as the effusion is rough and dry, or smooth and moist.

744. The hand applied to the spot where an abnormal sound is heard often perceives a peculiar *thrill*, like that felt on touching the back of a purring cat. This is called the purring tremor (*frémissement cataire*). A similar thrill is sometimes felt under strong pressure in the healthy arteries themselves, after profuse loss of blood, and in anæmia. It is also present over aneurismal tumors, in aortic dilatations, in arterial varix.

745. The most common sound in the vessels remote from the heart is the bellows murmur. This may always be produced, both in arteries and veins, by the firm pressure of the stethoscope, but is most distinctly heard in chlorotic females, and after hemorrhages. It is heard in the veins of the uterus during pregnancy, but may be produced by pressure of the stethoscope transmitted to the iliac veins or aorta.

746. The humming sound (*bruit de diable*) and the buzzing sound (*bruit de mouche*) are also heard under the pressure of the stethoscope in different states of the vessels, and in the large veins. They may be heard in most anæmic females by placing the stethoscope with a firm pressure in the supra-clavicular space; but they are not peculiar to anæmia. They are generally most distinct on the left side, but, in rare instances, are perceptible only on the right or only on the left.

747. This humming or buzzing sound is known from sounds due to the motion of the blood in the arteries by being continuous. Sometimes, as above the clavicles in extreme cases of anæmia, a humming sound, due to the motion of the blood through the veins, is heard at the same time with a bellows sound caused by its motion through the arteries.

748. The peculiar whizzing or grating sound of aneurism, and of aneurismal varix (an accidental opening from an artery into a vein), completes the history of valvular sounds.

4. The Pulse.

749. By the ear or hand applied to the region of the heart, we count the number, force, quickness, regularity, and degree of equality of its beats; but the pulse teaches us this and something more. It is a measure not only of the number, force, quickness, regularity, and degree of equality of the heart's contractions, but also of the quantity of blood sent forth at each beat. Hence it is a better measure of the circulation. It would be a perfect one were it not that the coats of the arteries vary in their contractility. But this circumstance gives the pulse an additional claim to attention; for it serves as an index of the state of the nervous system, by which the contractility of the arteries is determined.

750. Some precautions are necessary in examining the pulse and some directions are required. The first precaution is, to wait till the emotion occasioned by the presence of the medical attendant has subsided. For the purpose of counting the number of beats, a single finger may be used; but in order to observe the more minute changes of the pulse, the four fingers of the opposite hand should be applied in the course of the radial artery, with a moderately firm and equal pressure. By compressing the artery with the ring or little finger, we can ascertain by the forefinger the degree of compressibility. In infants and very young children, it is often difficult to count the pulse at the wrist, and in these cases the beat of the heart should be preferred. The pulse should, if possible, be counted while they are asleep.

751. Of all the characters of the pulse, its frequency is the one most easily ascertained. This usually corresponds with the number of the heart's contractions: it can never exceed, though it may fall short of it. In certain diseases of the heart the ventricles receive so little blood that no impression is made on the mass of the circulating fluid, and the impulse does not reach the radial artery; or the heart contracts without having any blood in it; or some pressure, temporary or permanent, exists in the course of the artery: in all these cases, the pulse is imperceptible, and we miss some of its beats. In syncope, all the beats of the heart are so feeble that no pulse can be felt at the wrist.

752. The number of the pulse in health varies with age, sex, and temperament; with posture, time of day, sleep, exercise, food; with mental emotions; with temperature and density of the air; with the quantity of blood in the body; and with the strength and vigor. Our principal information on this subject is condensed in the following pages:

753. Age.—*Infancy.*—The number of the pulse is very variable in infants. In the healthy infant asleep on the day of its birth, Heberden found it to be between 130 and 140; and according to Quetelet the num-

bers immediately after birth, both for males and females, are as follows: Maximum, 165; Minimum, 104; Mean, 135; Range, 61.

The following numbers are from Billard; the averages are approximations:

	Max.	Min.	Mean.	Range.
1 to 10 days,	180;	less than 80 (in 18)	106;	more than 100
1 to 2 months,	150;	" " 70 " "	103;	" " 80
1 to 3 months,	100;	" " 70 " "	87;	" " 30

The pulse of the infant at birth, and for some time after, is, therefore, very variable, and is little to be depended on as an indication of health.

754. From infancy till toward the middle of life, the number of the pulse progressively diminishes, to increase again slightly toward its decline. The following table, founded on an aggregate of about 700 observations, most of which were made by myself, shows, for the first 25 years of life, the average and extreme numbers of the pulse, without distinction of sex, time of day, or posture of the body. The table shows an uninterrupted fall from 128 to 90, in the first seven years of life, and a further fall (with irregularities due to the small number of observations) during the 18 years that follow; also a range, for the whole period of 25 years, varying from 56 to 29, and displaying a progressive decrease with fluctuations dependent on the same cause.

Age.	Max.	Min.	Mean.	Range.
1	158	108	128	50
2	136	84	107	52
3	124	84	106	40
4	124	80	105	44
5	133	80	101	53
6	124	70	95	54
7	128	72	90	56
8	112	72	92	40
9	114	65	87	49
10	120	76	91	44
11	100	56	84	44
12	120	70	94	50
13	112	70	84	42
14	114	68	86	46
15	112	60	84	52
16	104	66	83	38
17	102	54	76	48
18	104	58	74	46
19	108	60	76	48
20	106	52	72	54
21	99	59	74	40
22	96	41	68	55
23	100	60	74	40
24	84	52	71	32
25	88	59	73	29

755. The following table shows the number of the pulse at different ages, based on twenty-five observations at each age, all in apparently healthy persons, fasting, at rest, in the middle of the day, and in a sitting posture:

Age.	Males.				Females.			
	Max.	Min.	Mean.	Range.	Max.	Min.	Mean.	Range.
1 week, . . .	160	104	128	56	160	104	128	56
2–7 years, . .	128	72	97	56	128	70	98	58
7–14 " . . .	108	70	84	38	120	70	94	50
14–21 " . . .	108	60	76	48	124	56	82	68
21–28 " . . .	100	53	73	47	114	54	80	60
28–35 " . . .	92	56	70	36	94	62	78	32
35–42 " . . .	90	48	68	42	100	56	78	44
42–49 " . . .	96	50	70	46	106	64	77	42
49–56 " . . .	92	46	67	46	96	64	76	32
56–63 " . . .	84	56	68	28	108	60	77	48
63–70 " . . .	96	54	70	42	100	52	78	48
70–77 " . . .	94	54	67	40	104	54	81	50
77–84 " . . .	97	50	71	47	105	64	82	41

756. The pulse of the adult male, then, may be stated at 70, that of the adult female at 80; the highest number is somewhat less than 100 in the male, and somewhat more than 110 in the female; the least number in each is about 50. The range (difference between the highest and lowest numbers) extends from 28 to 56 in the male, average 43; and from 32 to 68 in the female, average 48; the lowest number in the table is 46; the lowest observed by Floyer was 55.

757. Much lower numbers have, however, been met with in healthy persons. Heberden records 42, 30, and even 26 beats in a man whose "chief distemper" was the age of fourscore; and Fordyce, 26, in an old man in the Charter-house. In a young man whose pulse is not included in the table (he suffered from slight dyspepsia, and has since died of phthisis), I have repeatedly counted as few as 38 beats; and in a medical man reduced to extreme weakness by a succession of exhausting maladies, and who had slowly recovered health and strength, I have counted as few as 30 beats; which, or a near approach to it, continues to be the usual number at an interval of some years from the date of his recovery. Pulses as low as 16 or even 14 are on record, but it is doubtful whether the persons examined were healthy. Falconer has observed pulses of 36 and 24 in women, and Dr. Graves one of 38.

758. In disease, extraordinarily small numbers have been counted; one case is reported by M. Piorry, in which there were 17 beats in a minute; in a case of epilepsy (Sir W. Burnett) the number was 14; Heberden was told of a pulse of 12 or 16; and in a remarkable case of injury to the

upper part of the spine, followed after an interval by fits of syncope with convulsions, the pulse was usually about 33, but fell during the fits to 12, 10, 8, "and at three or four different times, when the patient was quite insensible, and not in a fit," 7½ in a minute. (Mr. Holberton, in "Med.-Chir. Trans.," 1841.) These low frequencies of pulse are generally little affected by stimuli, and, as in the case reported by Dr. Graves, remain unaltered by febrile attacks.

The pulse often falls very low during convalescence from fevers and other exhausting maladies; and a very infrequent pulse has been specially noted among the anomalous symptoms of diphtheria.

759. On the other hand, there may be exceptions of an opposite kind —that is, cases of great frequency of pulse; but I have no well-authenticated instances to report. But in disease the pulse sometimes runs very high. Floyer thought that the greatest number which could be counted was 140; but Heberden met with a pulse of 180. Dr. Joy counted 200 in a case of acute hydrocephalus; and a medical man, as well as a medical friend of his, assured me that during occasional violent fits of palpitation he counted in his own person 250 beats in the minute; I have myself counted upward of 170 in pulmonary consumption; and during the rapid formation of diffused abscess of the arm, in a boy ten years old, suffering from a fatal attack of enteric fever, I distinctly counted 264 beats in the minute, being nearly nine in two seconds. Twice, when suffering from attacks of indigestion, I have counted, in my own person, without the watch, what must have been at least 250 beats. (G.)

760. *Sex.*—On comparing the two columns of the last table, it will be seen that the pulse of the female has nearly the same number as that of the male up to seven years, but that at more advanced ages the female pulse is in excess by from 6 to 14 beats, the average excess being 9. The pulse, too, has a greater range in the female; that is to say, there is a greater difference between its highest and lowest numbers; the pulse of women being often much more frequent than that of men, while in other instances it falls nearly as low.

761. As it is not easy to bear in mind the number of the pulse in the two sexes for the several periods specified in the tables, the following approximate figures may assist the memory :—

1. At birth,	140
2. Infancy,	120
3. Childhood,	100
4. Youth,	90
5. Adult age,	75
6. Old age,	70
7. Decrepitude,	75–80

An addition of about 10 beats will have to be made to 4, 5, and 6, in order to give the numbers in the female.

762. *Temperament.*—Nothing is certainly known of the influence of temperament. The pulse is probably more frequent in the sanguine and nervous than in the lymphatic and bilious ; but I have counted 50 beats in a youth under 20, with every mark of the sanguine temperament.

763. *Posture.*—In the healthy adult male the mean frequency of the pulse in the different postures is as follows :

Standing, 79 ; sitting, 70 ; lying, 67 ; including all exceptions.
Standing, 81 ; sitting, 71 ; lying, 66 ; excluding all exceptions.

In the adult female of the same mean age the numbers are—

Standing, 89 ; sitting, 82 ; lying, 80 ; including all exceptions.
Standing, 91 ; sitting, 84 ; lying, 80 ; excluding all exceptions.

764. The extremes are very remote from these mean numbers. Thus, in men, the difference between standing and sitting may be as high as 26, and as low as 0 ; that between sitting and lying as high as 18, and as low as 0 ; and that between standing and lying as high as 44, and as low as 0. In women, differences scarcely less marked have been observed. Numerous exceptions also exist to the rule that the pulse is more frequent sitting than lying, and standing than sitting. The effect of change of posture on the same number of the pulse is nearly twice as great in males as in females, and nearly three times as great in adults as in early youth.

765. The effect of change of posture increases with the frequency of the pulse, as is seen in the following tables :

	Males.				Females.		
	51–70	71–90	99–110	111–130	61–80	81–100	101–120
Standing,	61	81	101	120	71	92	108
Sitting,	55	68	82	93	67	85	97
Lying,	52	67	74	81	68	83	90
Difference between standing and lying,	9	14	27	39	3	9	18

766. The exceptions to the rule decrease as the frequency of the pulse increases, and for the higher numbers disappear. The effect of change of posture on the same number is greater in the morning than in the evening. When the head is placed lower than the body the pulse falls.

767. The number of the pulse in the different postures is determined by the muscular effort required to support the body in those postures.

768. The effect of change of position is much increased by debility, but diminished in phthisis pulmonalis, and, according to Dr. Graves, is reduced to zero in hypertrophy of the heart.

769. *Period of the Day.*—The pulse of the healthy male is, as a general rule, more frequent in the morning than in the evening, to diminish as the day advances. To this rule there are many exceptions in men, and still more in women. The fall is also more rapid and uniform in the evening

than in the morning. It is also a general rule that all exciting causes act more powerfully on the pulse in the morning than in the evening.

770. In experiments on the pulse in my own person I found that the effect of the same food on the same number of the pulse was, taking one experiment with another, nearly twice as great, and lasted more than three times as long in the morning; while in more than one instance the same food which in the morning raised the pulse from 5 to 12 beats, and kept it raised for one or two hours, had no effect whatever in the evening.

771. *Sleep.*—The pulse falls considerably in sleep. Quetelet found a difference of 10 beats in an adult female, the same difference in a girl from three to four years old, and in a boy from four to five years a difference of 16 beats. Sleeplessness excites the circulation.

772. *Exercise.*—This excites the pulse more than any other cause. It may raise it to more than three times its natural number. Change of posture is but a particular case of this. After severe and continued exertion the pulse suffers the same collapse as the other functions, and falls much below its natural number. Passive exercise also excites the pulse.

773. *Food.*—The pulse is little affected by vegetable food, more by animal substances, most of all by warm drinks. Spirituous liquors and tobacco, even though used habitually, raise it; cold liquids lower it.

774. *Mental Emotions.*—These have a marked effect on the pulse, the exciting passions raising it, the depressing passions lowering it. The apprehension which patients feel in the presence of their physician is well known to excite the pulse, and the caution not to count it till the excitement has ceased is as old as Celsus.

775. *Temperature of the Air.*—Cold air lowers the pulse, warm air raises it. When Sir C. Blagden remained eight minutes in air heated to 260°, the pulse rose to 144, double its natural number.

776. *Density of the Air.*—De Saussure found the pulses that beat 49, 66, and 72 times respectively at Chamouni, raised to 98, 112, 100 on the summit of Mont Blanc. Dr. Frankland's pulse after six hours' perfect rest and sleep, at the top of Mont Blanc was 120, on descending to the corridor it fell to 108, at the Grand Mulets it was 88, and at Chamouni, 56. His normal pulse was 60. (Kirke's "Physiology.")

777. *Quantity of Blood in the Body.*—The pulse is more frequent in that degree of plethora which falls short of overloading the heart; its frequency is but little increased when the heart is oppressed. Compression of the arteries raises the pulse by producing the first degree of plethora. A slight decrease in the quantity of blood lowers the pulse; a considerable decrease raises it.

778. *Debility.*—In debility without disease the pulse falls; it rises in extreme weakness, or when debility is complicated with irritation.

779. The common causes of increased frequency of pulse in healthy persons, therefore, are the following: Muscular exertion, active and passive exercise, a change from a posture requiring less effort to one requiring more, food (especially warm drinks, spirituous liquors, and tobacco), heat,

diminished pressure of air, extreme debility, sleeplessness, the first degree of plethora, and exciting passions and emotions.

780. The chief causes of diminished frequency, on the other hand, are sleep, fatigue (provided it be not carried to excess), change of posture from one requiring greater effort to one requiring less, the inverted position of the body, continued rest, debility without disease (provided it be not extreme), cold applied externally or taken internally, increased atmospheric pressure, and depressing passions.

781. Other characters of the pulse, besides its frequency, deserve notice. The pulse of healthy men may be described as regular, moderately full, compressible, and rising slowly under the finger; that of healthy women and children as smaller and quicker in the beat. The pulse in the sanguine temperament is full, hard, and quick; in the lymphatic temperament, slower in the beat. In old age the pulse is often rendered hard by the increased firmness of the arteries.

782. Exceptions also occur to the regularity of the pulse; instances having been observed in which the pulse was irregular or even intermittent in health, and regular in disease, resuming its intermittent character on recovery. Heberden records two cases in which the pulse that was both irregular and unequal in health, became regular during illness. In some persons this irregularity occurs on every slight attack of indigestion, especially where much flatulence is present. In other cases, where no other obvious cause exists, a severe attack of indigestion may raise the pulse to as many as 250 beats.

783. The number of the pulse, then, though a point of much importance, is not the only one that demands attention: it has other characters of at least equal value. The following description and explanation of them will be found useful:

784. The impression made on the finger by the pulse is compounded (*a*) of the beat of the heart, (*b*) of the reaction of the aorta and large vessels, (*c*) of the condition of the coats of the artery, (*d*) of the consistence of the blood, and (*e*) of the state of the aortic valves.

785. (*a*.) The characters of the pulse which depend upon the degree and mode of the heart's contraction are the following:

Number of the heart's contractions.—Pulse *frequent, infrequent.*

Regularity of the heart's contractions.—Pulse *regular, irregular:* (intervals unequal), *intermittent* (intervals equal).

Quantity of blood expelled by the heart.—Pulse *large* (full), *small:* quantity at each beat the same, pulse *equal;* different, *unequal.*

Time occupied by each beat of the heart.—Pulse *slow* (laboring), *quick* (sharp), *very quick* (jerking or bounding).

786. (*b*.) A healthy tone of the arterial wall produces a *steady* pulse; the absence of this occasions the peculiar *thrilling* pulse of aortic disease and of aneurism. The following modifications are due to this cause:

Contractility of the arteries increased.—Pulse *hard* (strong, sharp, wiry, incompressible).

Contractility of the arteries diminished.—Pulse *soft* (weak, yielding, compressible).

Elasticity lost in the large arterial trunks.—Pulse *jerking, thrilling, vibrating.*

787. (*c.*) The character of the pulse is further modified by the degree of contractility or *tone* of the muscular fibres in the coats of the smaller arteries. It exists in every degree from the tense state of high nervous excitement or rude robust health, down to the flabby condition of collapse, shock, or extreme debility.

788. (*d.*) The influence which the consistence of the blood has in modifying the pulse is best seen in extreme cases of anæmia, in which an important element being deficient, the pulse assumes the *thrill* that in other cases is due to a loss of elasticity in the arteries.

789. (*e.*) The state of the aortic valves has a marked effect on the pulse. In health their prompt closure keeps the arterial system full, and conduces to steadiness in the pulse. But when the valves are diseased and patent so as to allow regurgitation into the left ventricle, each pulse is peculiarly distinct, the wave caused by each contraction being felt as if the blood were "shot under the finger," the vessel in the interval being unusually empty. This is an exaggeration of the *jerking* pulse of anæmia.

790. The foregoing characters of the pulse are rarely, if ever, met with separately, but admit of various combinations, of which the following are the most important:

Pulse *frequent, large, soft.*—(Compounded of a frequent beat of the heart, a large quantity of blood sent out by each contraction, and an artery wanting in elasticity and tone.) This pulse accompanies the premonitory stage of many febrile and exanthematous diseases, and it is present in dilatation of the left ventricle.

Pulse *frequent, large, hard.*—(Compounded of a frequent beat of the heart, a large quantity of blood sent out at each beat, and an artery full of elasticity and tone.) The pulse of the first degree of plethora and of hypertrophy with dilatation.

Pulse *rather frequent, large, slow* (laboring).—(Compounded of a rather frequent and slow beat of the heart, and a large quantity of blood sent out at each contraction.) The pulse of a greater degree of plethora, the heart overloaded with blood.

Pulse *frequent, large, hard, quick.*—(Compounded of a frequent and quick beat, a large circulation of blood, and an artery full of elasticity and tone.) The pulse of inflammatory fever.

Pulse *frequent, large, hard, thrilling.*—(Compounded of a frequent beat, a large quantity of blood, the artery at the wrist elastic and full of tone, with a loss of elasticity in the larger arteries.) The pulse of aneurism; and of dilated aorta, without obstruction to the flow of blood.

Pulse *frequent, small, quick.*—(Compounded of a frequent beat, a quick contraction, and a small quantity of blood sent out at each beat.) This is the characteristic pulse of phthisis in males, and of anæmia in females. In

a moderate degree, indeed, it is the character that marks the female pulse, and is present in an exaggerated form in all the less severe disorders of women. With the addition of extreme hardness, it is the pulse of hypertrophy with contraction of the heart.

Pulse *unequal* and *irregular, frequent* or *infrequent.*—(Compounded of a variable quantity of blood sent out at each contraction, and of contractions performed in unequal times.) As the quantity of blood sent forth by the heart may depend upon one of two causes—diminished supply from the auricle, or want of power in the heart—this pulse may indicate mitral valve disease, or atrophy or softening of the heart. It may depend, also, on causes which render the supply of blood to the left auricle variable. Hence it occurs in some diseases of the lungs. A similar pulse may occur suddenly as the consequence of the formation of a large polypus in the left ventricle, or from pressure on the heart by effusion into the pericardium.

Pulse *infrequent, large, hard.*—(Compounded of an infrequent beat, a full supply of blood, and an artery in a state of elasticity and tone.) A pulse met with in apoplexy before depletion has been practised, in hydrocephalus, in compression of the brain, in narcotism, and in simple hypertrophy of the left ventricle.

Pulse *infrequent, quick.*—(Compounded of an infrequent and a quick beat of the heart.) A pulse sometimes met with in the hysteric female, and in very rare cases of phthisis in the male.

791. These are the leading combinations of the chief elements of the pulse. They are given partly as examples of the use of terms, partly as hints to those who may wish to follow out the study of the pulse.

792. Taken in combination with other symptoms, the pulse furnishes important indications in all diseases; while in pulmonary consumption and diseases of the heart and arteries, it often gives the earliest clue to the existence of an obscure and lurking malady. Hence its importance to the medical examiners of insurance offices.

793. It must not, however, be supposed that the pulse is free from the uncertainties that attach to all other symptoms of disease. On the contrary, we encounter, from time to time, remarkable exceptions to general rules. There are no characters of the pulse, for instance, more generally present than those just indicated as occurring in pulmonary consumption, especially in men; but among some hundreds of cases conforming to the rule of increased frequency, we meet with a single case in which the number falls short even of the average in health. In one case I counted a pulse of 64 in the erect posture. The dyspeptic patient referred to at § 757, as having a pulse of 38, died several years afterward of pulmonary consumption. In other diseases and states of system usually characterized by great frequency of pulse, very curious exceptions do occasionally take place. There have been epidemics of continued fever characterized by a very low frequency; and cases of all the more severe febrile disorders marked by the same curious exceptions to the rule. Thus, Dr.

Wells counted a pulse of 58 in a boy eight years of age, suffering from anasarca after scarlatina. Of the striking difference of frequency that may exist in two persons suffering from the same disease, Heberden gives a good illustration. Two young women were ill of the same infectious fever, and the pulse of the one was never above 84, while the pulse of the other was counted as high as 180. Both recovered. The low frequency in the first case was thought to be due to the state of the brain, "which was affected comatosely."

794. The pulse in disease is also subject to great variations in the same persons, either within short intervals of time, or in states of system in other respects apparently the same. Thus, it is not uncommon in typhus fever to find the pulse varying in a few hours from 40 or 50 beats to 120 or 130; and in a case of phthisis, the pulse, which was 64 in one attack, was 120 in a second, not distinguishable from the first by any other symptom.

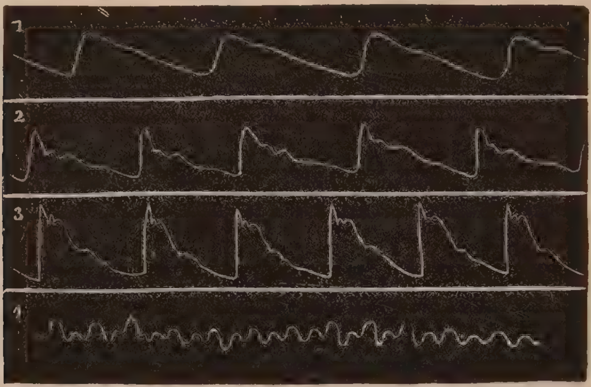
Changes in the frequency of the pulse in either direction afford very important indications in disease. Thus, Heberden remarks, "that before some critical swelling or deposit of matter begins to show itself in fevers, the pulse will be so rapid and indistinct as hardly to admit of being counted," a statement confirmed by the case cited § 759. The same accurate observer tells us that if, in an illness, a pulse of feverish quickness all at once becomes quiet, while all the other bad signs are aggravated, we are to suspect a translation of the diseased condition to the brain, and to apprehend apoplexy, palsy, or death; and, again, that if the pulse of a child be 15 or 20 below the healthy standard, with signs of considerable illness, the brain is certainly affected.

795. Besides the simple characters of the pulse already described, others less common and more obscure have been mentioned by authors, of which the following are examples:—The redoubled pulse (*dicrotus, bisferiens, bisiliens*), when two strokes follow each other rapidly, and are separated from the two succeeding ones by a pause—a pulse said to indicate approaching hemorrhage; the *incident* pulse (*incidens, inciduus*), when the second pulsation is weaker than the first, the third than the fourth, after which there is a stroke as strong as the first: this is the critical pulse of the old writers; the *pulsus caprisans,* admirably named, but rarely felt; it consists in a small pulse, succeeded after a short interval by a large one, conveying the impression of an unsuccessful effort, followed by the overcoming of an obstacle.

Much light has been already thrown on the variations of the pulse in health and disease, and more may be confidently expected, by the use of the sphygmograph invented by M. Marey, and improved in some minor details by Dr. Sanderson. This ingenious instrument may be described as a skilful combination of springs and levers, by which all the changes that occur in the radial artery in a short period of time can be correctly exaggerated and traced on paper, or on an oblong fragment of smoked glass.

It may be well to show by examples the striking differences that have been ascertained to exist between the pulse in health and in one or two diseased conditions. The curves in Fig. 50 show—1. The firm, long pulse of vigorous health. 2. The soft pulse of ordinary health. 3. The hard pulse of chronic Bright's disease. 4. The undulatory pulse of typhus. It

Fig. 50.



will be seen that the number of the pulse is indicated as well as its character. Thus, the pulse in 1, is 50 ; in two 56 ; in 3, 70 ; in 4, 160. These outlines are selected from the plates given by Dr. Sanderson in his excellent "Handbook of the Sphygmograph," to which the reader is referred for fuller information.

5. The Respiration.

796. The number and character of the respiratory movements, and the relation they bear to the circulation, frequently engage attention at the bedside. In order to appreciate rightly their value as signs of disease, it must be borne in mind that the muscles of respiration are under the control both of voluntary and involuntary nerves, and that their subordination to the will renders them liable to all those affections of the voluntary muscles in which volition is suspended, lost, or interfered with, such as chorea, tetanus, and hysteria.

797. As respiration may be in part a voluntary act, it is necessary in experimental inquiries to eliminate the disturbing element of the will. This is best done by means of such an instrument as will register the number of respirations during a considerable interval without requiring the attention of the experimenter. (See § 672.)

798. At the bedside this object may be secured by placing the hand of the patient on the abdomen, as if to count the pulse. By relaxing the grasp on the wrist, and allowing the hand to rise and fall with the movements of the abdomen, the respirations may be counted, without attracting attention to the breathing, and the pulse and breathing counted in

succession, and compared. This precaution of holding the wrist should be observed even when, the respirations being audible, we prefer to count them by the ear.

799. *Number of the Respirations.*—This is subject to as much variety as that of the pulse. It is usually stated at 18 in the minute, or about one to every four beats of the pulse. For the adult male the estimates of authors vary from 14 to 26 in a minute.

800. The respiration, like the pulse, varies in frequency with age, sex, posture, and time of day—with exercise, rest, and sleep.

801. *Age and Sex.*—Quetelet got the following results from about three hundred observations on males, and fewer on females:

	Number of the Respirations.	
Age.	Male.	Female.
At birth,	23–70	27–68
5 years,	32	—
15–20 "	16–24	19
20–25 "	14–24	17
25–30 "	15–21	—
30–50 "	11–23	19

802. The range of my own respiration, from my twenty-eighth to my thirtieth year, as founded on numerous experiments with the self-registering instrument, in different postures and circumstances, was 12 to 22. (G.)

803. Vierordt obtained, as the result of observations on his own person, in the *sitting* posture, a maximum of 15, a minimum of 9, and an average of 12. Hutchinson, in rough and inexact experiments on 1,714 healthy males in the same posture, found a minimum of 6, and a maximum of 41; while the greater number were found to breathe 20 times in the minute, and a very large proportion between 16 and 24 times. The recorded frequency of respiration in the persons of the principal experimenters on that function ranges from 14 to 27.

804. *Posture.*—The results of a large number of observations, made on my own person, by the self-registering instrument, were as follows: For a pulse of 64 the respirations were, standing, 22; sitting, 19; and lying, 13. Hence the rule of the pulse—that the difference between standing and sitting is greater than that between standing and lying—is inverted in the case of the respiration. The respiration in the sitting posture, for different frequencies of pulse, ranged from 15 to 21. (G.)

805. *Period of the Day.*—The pulse becomes less frequent as the day advances, but the respiration becomes more frequent. For the same number of the pulse, there are about 18 respirations in the evening for 17 in the morning. The same rule obtains in disease in both sexes.

806. *Sleep.*—In a woman, ætat. 27, Quetelet found the respirations to be, awake, 27; asleep, 21. In two young children the differences were 5 and 8 respectively. In his experiments the respiration was more affected by sleep than the pulse.

807. The other causes which in health affect the frequency of the pulse, produce a like effect on the breathing. Thus, all causes which increase the frequency of the pulse and the force of the circulation, also augment the number of respirations, and the reverse. Exercise increases the number of respirations, rest diminishes them : heat increases and cold diminishes the frequency both of the pulse and breathing. Sleep, which lowers the pulse, lowers still more the breathing. The only exception to the rule is that of debility ; for weakness without disease, if not extreme, is attended by an infrequent pulse, while the number of respirations is increased in every degree of debility.

808. *Proportion of the Respiration to the Pulse.*—This has been variously estimated by authors, at 1 to 4, 1 to 4½, and 1 to 5. But these estimates were formed in ignorance of the effect of posture on the breathing. In experiments on my own person, made with the self-registering instrument, the proportion has varied between 1 to 2.60 and 1 to 5.23 ; and in the sitting posture from 1 to 2.61 to 1 to 5.00. (G.)

The chief causes of the different ratios of pulse and respiration are posture, time of day, and number of the pulse itself.

809. *Posture.*—For a pulse of 64, the proportion, standing, was 1 to 2.95 ; sitting, 1 to 3.35 ; and lying, 1 to 4.97.

810. *Time of Day.*—The proportions morning and evening for the same frequency of pulse are about 1 to 3.60 and 1 to 3.40.

811. *Number of the Pulse.*—The ratio of the respiration to the pulse decreases as the pulse increases ; for a pulse of 54, being 1 to 3 ; for a pulse of 72, 1 to 4. As a general rule, the number of respirations increases with that of the pulse, but in a less rapid ratio, the proportion decreasing as the pulse increases. It is believed that these statements, founded on my own observations will be found in the main correct. (G.)

812. In disease the number of respirations varies within much wider limits than that of the pulse. The smallest number I have counted is 6 in a female in a deep sleep, but not comatose, after attempting suicide by laudanum ; and I have counted as few as 10 respirations in a case of paralysis. On the other hand, I have reckoned as many as 44 in a case of phthisis, 73 in a case of paralysis agitans, and 140 in a case of hysteric asthma. (G.) Floyer met with 60 respirations in a case of suffocative catarrh, and in a case of inflammation of the lungs in a child ; on the other hand, he counted as few as 7 in more than one attack of asthma. Dr. Graves has recorded as few as 12, and as many as 50, in cases of fever.

813. *Ratio of the Respiration to the Pulse in Disease.*—Floyer found it as high as 1 to 2 in a case of suffocative catarrh, and as low as 1 to 14 in one of asthma ; Dr. Graves as high as 1 to 2 in one case of fever, and as low as 1 to 20 in another. In the case of paralysis agitans already referred to, I counted a pulse of 72 and 73 respirations ; in a case of hysteric asthma, 144 pulses and 140 respirations ; in a case of transposition of the heart, 32 respirations to 46 pulses ; and in a case of paralysis, 1 respiration to 6½

pulses. In a case of aneurism of the heart, there were 34 respirations to 33 pulses. (G.)

814. These variations in the number of respirations as compared with that of the pulse are readily explained, if we reflect that the respiration is influenced by many causes besides the quantity of blood sent to the lungs by the heart. Some of these are internal, some external. The principal internal causes are the state of the lungs themselves, and of their investing membrane. Among external causes are mechanical obstructions, such as the pressure of tumors on the air-passages, constriction of the chest, increased or diminished action of the muscles of respiration, etc. All these obstructions to the free play of the lungs quicken the breathing; and this, whether accompanied by a feeling of uneasiness or not, has been called *dyspnœa.* As this is the chief symptom of all diseases of the lungs, and a concomitant of a great majority of diseases of the heart, its chief causes are here presented in a tabular form.[1]

CAUSES OF INCREASED FREQUENCY OF RESPIRATION, OR DYSPNŒA.

I. *Quantity of blood in lungs increased.*	
a. With quickened circulation.	Exercise, repletion, plethora (1st degree), inflammatory fevers, hypertrophy of the right side of the heart.
b. With obstacle to return of blood to the heart.	Diseases of the mitral valve, pressure on the pulmonary veins, etc.
II. *Quality of the blood altered.*	
a. More venous than usual.	Morbus cœruleus, etc.
b. Red particles deficient.	Anæmia, chlorosis.
III. *Deficiency of oxygen.*	
a. Air pure, but small in quantity.	Air rarefied by high temperature, or diminished atmospheric pressure.
b. Air defective in quality.	Non-poisonous gases, as nitrogen and hydrogen.
IV. *Mechanical obstructions.*	
Internal.	*Internal.*
a. Of the air tubes.	Diminished size from thickening of walls, from pressure, and from accumulations of mucus.
b. In lungs themselves.	Congestion, hepatization, œdema, tubercle, etc.; emphysema, dilated bronchi, vomicæ, etc.

[1] A similar table is given by Dr. Williams in Lib. Pr. Med., vol. iii., p. 25.

Internal.	*Internal.*
c. In pleural sac.	Hydrothorax and pneumothorax, pleuritic affections and adhesions.
d. Caused by other organs.	Enlargement of the heart or large vessels, aneurismal tumors.
External.	*External.*
a. In parietes of chest.	Malformations and distortions, ossification of cartilages, etc.
b. In abdomen.	Enlarged viscera, tumors or dropsical effusions.

V. *State of the muscles of respiration.*

a. Paralysis (partial).	Injuries of the spinal marrow, in the neck, etc.
b. Debility.	From fatigue, from exhaustion, after severe febrile affections, and at the approach of death.
c. *Pain.*—1. In muscles.	In intercostals, diaphragm, or abdominal muscles, those acting which are free from pain.
2. In surrounding parts.	In the abdomen in peritonitis, in the chest in pleurisy, the muscles that cause last pain acting alone.
d. Spasm.	Tetanus, hydrophobia, etc.
e. Other forms of augmented innervation.	Strong mental emotions; hysteria, asthma.

815. The chief causes of diminished frequency of respiration are sleep and coma, whether produced by narcotics or by cerebral pressure. Hence the breathing is slow in apoplexy, and in narcotic poisoning.

816. Other characters of the respiration besides increase of number, merit attention; as the full or deep, the small or feeble, the equal or unequal; the regular or irregular, the short, quick, and catching; the long, the laboring; the thoracic, the abdominal, and diaphragmatic.

817. A peculiar respiration associated with fatty degeneration of the heart has been described by Drs. Cheyne, Stokes, and Sibson. The patient, after being in a state of apnœa for a quarter of a minute or more, has a feeble respiration followed by a succession of breathings, increasing up to a maximum of strength, and then as gradually diminishing.

818. The number of respirations taken by itself is of little valne; but when combined with observations on the pulse, or examinations of the chest by percussion and auscultation, it may be significant. Thus, a frequent respiration, taken alone, may arise from any one of the many causes specified in the table; but coupled with an infrequent pulse in the ascertained absence of visceral disease, it indicates great debility; or, in its absence, hysteria. On the other hand, an infrequent pulse and respiration

combined would as probably arise from some disease or injury of the brain, or of the upper part of the spinal cord. Again, a frequent and quick respiration, without visceral disease, but attended by acute pain of the chest or abdomen, is explained by the existence of that pain, whether its seat be the muscles or the peritoneum.

819. Important indications may also be obtained by noting the number of respirations day by day in acute diseases. In pneumonia, for instance, a daily diminution in the number, with or without a similar change in the pulse, gives good hope of recovery; in apoplexy or in narcotic poisoning, on the contrary, a rise in the number, especially if attended by increased frequency of pulse, may be considered a good symptom. So in convalescence from fever, or other exhausting malady, a falling respiration with a rising pulse is a sure sign of returning strength.

820. In using these, as well as the less important symptoms and signs of disease, the observer should be on his guard against the common error of trusting implicitly to any one sign, however valuable, to the neglect of others capable of affording useful information. In diseases of the chest, for instance, neither stethoscopic signs, nor respiration, nor pulse alone, can furnish the practitioner with all the information which he wants; but, if, knowing the exact value of each of these signs, and the fallacies attaching to each, he uses all of them at the same time, there are few difficulties in diagnosis which he will not be able to overcome.

6. Other Symptoms and Signs of Disease.

821. Besides the signs and symptoms examined in the first five divisions of this chapter, there are many others of which it is easier to recognize the importance than to arrange them in a manner free from objection. Some of them, as the expression of the countenance, the appearance of the tongue, and the presence or absence of pain, are subjects of observation and inquiry in every case without exception; while others, as the appearance of the sputa, or of the discharges from the bowels, are noted only, or chiefly, in diseases of the lungs, or of the primæ viæ. Yet these symptoms of larger import often associate themselves very naturally with others of very limited application—*e. g.*, the appearance of the tongue with that of the lips and gums in anæmia; so that it seems reasonable to group them together, and to treat them in connection with each other. Accordingly, the remaining symptoms and signs will be examined in this section under the distinct heads of—1. The organs of digestion. 2. The organs of circulation. 3. The organs of respiration. 4. The urinary and genital organs. 5. The nervous system. 6. The temperature of the body. 7. The expression of the countenance, and the condition and attitude of the body.

822. (1.) The Organs of Digestion.—The condition of the alimentary canal is revealed to us in part by the state of the tongue; in part by alterations in the functions of the stomach and intestines, such as nausea, vom-

iting, and purging ; and in part by the character of the matters voided from the stomach and bowels.

823. The value of the *tongue* as a symptom or sign of disease, and an aid in diagnosis and prognosis, will be understood if it is borne in mind that it consists of a dense mass of muscular fibre, largely supplied with blood, covered with a secreting membrane, and lying in a bath formed of the secretions of the mouth and salivary glands. It may, therefore, be expected to indicate the state of the muscular and nervous systems, of the circulation, of the secretions generally and especially of those of the alimentary canal, to which it belongs by continuity of membranous covering, and as subserving the function of mastication.

824. The tongue has not the same appearance in all healthy persons. In some it is habitually clean, in others slightly furred ; in some florid, in others pale ; in some compact and firm, in others flaccid and indented by the teeth ; in some it is broad and flabby when protruded, in others strongly contracted and drawn to a point. Even in the most healthy persons it is covered with a thin white fur in the morning before taking food, and those who sleep with the mouth open, awake with a perceptible dryness of tongue.

825. In disease the tongue presents a variety of appearances. As to *size*, it is swollen in inflammation of the organ itself, in severe diseases of the adjacent parts, in salivation from mercury, and in malignant disease ; on the other hand, its size is diminished when there is much emaciation. The swollen tongue is often indented by the teeth, an appearance which it also wears in that relaxed and flabby state that often accompanies great weakness. Its *form* varies with the mode in which it is protruded ; but as a general rule, it is small and pointed in "irritation" broad and flabby in exhaustion. The *temperature* of the tongue is low in syncope, apnœa, and, in common with the breath, very low in cholera. Its *color* coincides, to some extent, with that of the general surface, being florid in plethora ; pale after profuse discharges, in anæmia and allied states of system, and in many chronic wasting maladies; and livid in apnœa and in diseases of the heart and lungs which greatly impede respiration. Its color also depends on the state of the digestive organs ; being universally red, or red at the tip, or at the edges, or both, in some cases of acute inflammation of the mucous membrane of the stomach and bowels. It is also very red and tender in some cases of scarlatina, and in continued fevers after the disappearance of the fur. A smooth red tongue, sometimes known as a "glazed" tongue, is often present in fever attended by great irritation of the stomach and bowels, and in idiopathic affections of those organs. The tongue is also red in acute inflammation of the throat. In poisoning by the mineral acids it is stained of characteristic colors, and has its epithelial covering partially or wholly removed.

826. Much importance attaches to the state of the tongue in respect of *moisture*. As the tongue of a healthy person is kept moist by the secretions of the mouth, and by the saliva, it becomes dry when those secretions fall short of the quantity required to supply the loss by evaporation and

that which from time to time passes down the gullet in the act of swallowing. It is obvious, therefore, that the tongue must afford a valuable index of the state of the secreting organs, and of the condition of the circulation, as promoting or retarding their proper functions. Accordingly a dry tongue, such as exists in inflammatory and febrile states of system, indicates a state of circulation unfavorable to secretion in other organs as well as in the tongue and mouth. On the other hand, a moist tongue indicates a favorable state of the secretions generally, and the absence of any high degree of inflammation or fever; and it is obvious that a transition from a dry to a moist tongue must always be a favorable sign. Hence, in cases of fever, the physician carefully inspects the tongue, examines it by the touch, and hails a moisture appearing at the edges, and gradually extending to the centre, as the sign of a freer state of all the secretions, and a mark of approaching convalescence. Again, a moist and flabby tongue, indented by the teeth, is justly regarded as a sign of want of tone and vigor.

827. A *fur* collects on the tongue in almost all severe diseases:—a white creamy fur in the first stage of fever, in catarrh, in quinsy, in most severe inflammations, and in acute rheumatism; a thick brown or black coating in more advanced stages of fever; or the tongue is dry, parched, and tender. A thick, black, dry fur, with black *sordes* about the teeth, is seen in the typhous stage of fever, and in low typhous conditions of the system, coinciding with a highly impure state of the blood, with unhealthy secretions, and fetid discharges from the bowels. A brown, dry fur exists in cases of local irritation, the tongue becoming moist as the irritation subsides. In jaundice the fur is sometimes tinged with bile, and in scurvy it is blackened by effused blood. In dyspepsia, the appearance of the tongue is very variable. A thick fur may collect at the base, while the tip and edges are bright red; or the fur extends over the whole surface, and is accompanied by indentations of the teeth, by partial abrasions of the epithelium, and by deep cracks, which are often strongly marked in spirit drinkers. Deep, foul ulcers of the tongue, with hard borders, are common consequences of syphilis. In constipation the tongue is sometimes covered with a brown fur; but it may present no unusual appearance.

828. The tongue has usually a characteristic appearance in scarlatina. The elongated florid papillæ protrude through a white coating of fur; or, the tongue, being bright red and free from fur, the papillæ appear distinct on the red ground. In the first case the tongue resembles a white, in the second a red, strawberry.

829. In common with the lining of the mouth and throat, the tongue may be the seat of small superficial ulcers, known as *aphthæ*. These are common in infancy, when they constitute the "thrush;" also in the last stage of pulmonary consumption, and toward the fatal termination of other chronic visceral diseases.

830. The mode in which the tongue is *protruded* is often characteristic. Sometimes it is tremulous in extreme weakness, in cases of idiopathic

fever with debility, and under the influence of fear. It is protruded with difficulty when dry; slowly and hesitatingly in diseases accompanied by stupor, in which case it is withdrawn after an interval, and as if in consequence of deliberation. In partial paralysis the tongue is protruded either toward the sound or the affected side of the face.

831. The *gums* afford signs of the state of the circulation, not of the digestive organs. They are florid in plethora; pale in anæmia; livid when respiration is much impeded; swollen and dark, and apt to bleed on the slightest touch, in sea and land scurvy; swollen with a red line in mercurial salivation; marked with a blue line in lead poisoning.

832. The *lips* and membrane of the mouth, like the gums, indicate the state of the circulation. They are pale in anæmia; dry and parched when the tongue is similarly affected, the seat of aphthous ulcers in young children, in consumption, and toward the close of febrile and inflammatory affections. An herpetic rash on the lips is a common and characteristic accompaniment of severe catarrh.

833. The *teeth* afford some useful indications. During the first dentition they are sometimes the source of much suffering, of severe febrile symptoms, of marked disturbance of the functions of the alimentary canal, of convulsions, and of eruptive diseases. In later life, sound teeth are an indication of vigor, and their early decay is one of the marks of a feeble or scrofulous constitution. They are wrinkled and imperfectly developed as the result of syphilitic taint, or of illness during dentition. Caries of the teeth may, however, be induced by habitual indigestion, by the excessive use of sweets and acids, and by the abuse of mercury. Workmen who handle mercury are subject to chipping of the teeth. The teeth grow loose in scurvy, and during salivation with mercury. They are covered with dark brown or black sordes in continued fevers and in typhous states of system. *Grinding* of the teeth in sleep is common in children suffering from worms or other intestinal irritation; and *chattering* of the teeth accompanies the severe shiverings that usher in many febrile disorders, and form part of the ague fit, as well as a prelude to the formation of matter.

834. The *fauces* and *tonsils* are subject to chronic inflammation and swelling, and the *uvula* to relaxation, indicating a want of constitutional vigor. The same parts are the seat of inflammation in scarlet fever, diphtheria, and severe catarrh; and of ulceration in secondary syphilis. The tonsils are liable to intense inflammation and great enlargement in quinsy, and they are the seat of a painful chronic irritation in public speakers who use the organs of speech unskilfully.

835. *The Saliva.*—An increased flow of saliva may occur as the result of irritation of the salivary glands, in inflammation of the mouth and parts adjacent, or as the consequence of dentition in children, and of unsound teeth in the adult; sometimes, again, as an effect of certain active medicines, such as mercury, iodine, antimony, and their preparations, of prussic acid and digitalis. An increased flow of saliva is not uncommon in pregnancy. Mercurial salivation is distinguished by soreness of the gums, a

brassy taste, and a peculiar fetor. Frothing at the mouth, due in part to increase of saliva, and in part to increased mucous discharge from the air-passages, is a common symptom of epilepsy and hydrophobia, in the first of which the froth is, as it were, churned out of the mouth by convulsive movements of the muscles of the tongue, mouth, and lips; while in the second it is ejected between the closed teeth. Salivation attends one form of paralysis.

836. *The Taste.*—The sense of taste is impaired in all diseases in which the nostrils are swollen or obstructed, as in catarrh; or in which the tongue becomes dry or furred. When the lingual and glossopharyngeal nerves are diseased; and occasionally in apoplexy. A bitter taste is often present in jaundice, and on waking in the morning in persons suffering from feverish attacks or from severe dyspepsia; and it may be caused instantaneously by strong mental emotion. Consumptive patients often complain of the salt taste of their sputa, and a putrid taste is present in diseases in and about the mouth attended by decomposition. Some dyspeptics also complain of a taste like rotten eggs; and a brassy taste is one of the signs of mercurial salivation. It is probable that the sense of taste is subject to illusion in madmen who swallow their vomited matters, urine, and fæces.

837. *The Appetite.*—Loss of appetite (anorexia) and distaste for food (nausea) are among the earliest symptoms of indisposition and the most constant attendants of severe illness; on the other hand, a restored appetite is among the earliest indications of convalescence. A failing appetite, again, is an unfavorable symptom in chronic maladies, and in advanced age; but it may be caused in persons not suffering from disease by want of exercise and fresh air, and by depressing passions. A voracious appetite is an occasional result of irritation of the stomach, or of intestinal worms; and it is sometimes a disease of itself, not easily traced to its true cause. It is often present in the mesenteric disease of children, in whom that part of the food which should have nourished the body is prevented from entering the lacteals. A voracious appetite is also common during established convalescence, obviously as a means of repairing the wasted body. Intense hunger is one of the after-effects of Indian Hemp. In some cases it is associated with frequent vomiting of food, as in inflammation attacking the stomach near the pylorus. A depraved appetite (pseudorexia) occurs in pregnant females, in chlorosis, and in hysteria, and in some forms of insanity.

838. *Thirst* is a common symptom of disease. It is present in active inflammations, and in violent febrile attacks, in consequence, probably, of the tongue, mouth, and throat partaking of the vascular fulness of the whole system, and suffering from a distressing dryness. It also occurs in accidents and diseases attended by sudden loss of blood, or rapid outpouring of some important secretion, as in diarrhœa, dysentery, and cholera; in diabetes; in some forms of dropsy; and in cases of phthisis attended with profuse perspiration. In healthy persons it always follows

strong exercise, and it is the most urgent suffering of the soldier on the march, and of the wounded on the field of battle. It is also a consequence of the excessive use of saline matters, as in the sailor fed on salt meat, and, in a less degree, of condiments taken to excess; it is common in the intemperate, and is a leading symptom of irritant poisoning.

839. The *Odor of the Breath.*—Liquids having a strong and peculiar odor, or imbibing it from food with which they are mixed, pass readily from the stomach into the circulation, and being eliminated by the lungs, taint the breath. The odor of spirits, due to this cause, sometimes enables the medical man to distinguish the effects of intemperance from an apoplectic seizure. A foul breath is among the symptoms of dyspepsia, of that unhealthy condition of body known as *cachexia*, of salivation, of advanced stages of fever, of scurvy; and generally of inflammations in and about the mouth, attended by decomposition, or followed by gangrene. The breath is extremely offensive in gangrene of the mouth, and in caries of the teeth. It has the odor of honey in saccharine diabetes.

840. *Vomiting* as a symptom of disease can only be duly appreciated by bearing in mind that the stomach is not merely the chief organ of digestion, but in close nervous relation with the brain, heart, and lungs. Vomiting, therefore, may be a symptom of disorder or disease in the stomach, as well as a consequence of severe injury or disease of the more important organs of the body, or of shocks to the nervous system. Among the causes affecting the alimentary canal, may be mentioned simple overloading of the stomach; irritating food; inflammation of its mucous membrane, by whatever cause produced; obstruction to the passage of the food through the pylorus, as in cancer of the stomach; permanent obstruction to the passage of the fæces through the intestines, as in ileus and strangulated hernia; and inflammation of the entire alimentary canal, as in English and Asiatic cholera. Vomiting is also a common effect of irritant, and narcotico-acrid poisons, and sometimes attends poisoning by the pure narcotics, especially carbonic acid. It is also a common effect of chloroform. To the more indirect and remote causes of vomiting belong concussion of the brain, the condition of the brain preceding an apoplectic seizure, and inflammation of its substance and membranes. Vomiting, again, accompanies the passage of gallstones, and of renal calculi, and severe inflammation of the heart, and of the womb. It is also very common in delicate females, and is one of the most constant symptoms of pregnancy. Lastly, vomiting is often amongst the earliest premonitory symptoms of severe attacks of the febrile exanthemata, particularly small-pox.

In vomiting dependent on diseases of the stomach and bowels, it is important to note the time after a meal at which it occurs. As a general rule, if it follows immediately, or quickly, it is attributable to inflammation of the mucous membrane of the stomach itself. In ulcers of the stomach food is retained longer. If the food is rejected after an hour or more, the cause may be traced, with great probability, to the pylorus or

duodenum. When, instead of a single act of vomiting ushering in an attack of illness, the vomiting recurs again and again, it must be looked upon as an unfavorable complication, except in pregnant women.

841. *Vomited Matters.*—We are often assisted in our diagnosis by examining the matters rejected from the stomach. The food is returned nearly unchanged in irritation, inflammation, ulceration, or obstructive disease of the stomach itself, in pregnant women, in vomiting due to remote constitutional causes and nervous shocks, and under the operation of many irritant poisons. Clear acid liquids are vomited after an interval of from half an hour to two hours or more in the disease known as gastralgia or gastrodynia. Bile regurgitates from the duodenum, and is discharged by vomiting, in functional and organic diseases of the liver. Blood is often discharged in very large quantities in the disease known as hæmatemesis; generally of a dark color, clotted, and mixed with food; rarely of the florid hue of hæmoptysis. The blood so discharged may flow from the general surface of the stomach, or from one or more ulcers in the mucous membrane; or it may regurgitate through the pylorus from the duodenum. A discharge of a large quantity of florid blood may be the result of an aneurism bursting into the stomach. A brown grumous matter, often mixed with blood, is rejected from the stomach in poisoning by the corrosives. Vomiting of purulent or muco-purulent matter points to the rupture of an abscess of some neighboring viscus. Feculent vomiting is a symptom of mechanical obstruction of the lower portion of the intestinal canal, or of a fistulous communication between the stomach or upper part of the small intestines and the colon. In a highly acid state of the contents of the stomach, a clear acid liquid with a brown frothy scum, abounding in small, round, black flakes, is sometimes vomited. These, when placed under the microscope, are found to contain the vegetable growths described by Goodsir as *Sarcina ventriculi.* (Fig. 51.)

Fig. 51.

842. The *bowels* are variously disordered; sometimes confined from torpor, from the absence of their natural stimulus, from mechanical obstruction, or from the operation of the poison of lead; sometimes relaxed, from inflammation of the mucous membrane, whether caused by previous constipation, unwholesome food, purgative medicines, or irritant poisons. Diarrhœa is also the usual result of ulceration of the intestines in enteric fever and in phthisis; it is frequently present in advanced stages of tabes mesenterica, and very prevalent during the heats of summer. It is an occasional consequence of a change of residence from cold to hot climates, and from low situations to elevated ones. Strong mental emotions also sometimes give rise to diarrhœa. Associated with vomiting it constitutes cholera, and is a leading symptom of irritant poisoning. Frequent and scanty discharges of watery stools with mucus, pus, or blood, accompanied by tenesmus, mark the disease known as dysentery.

843. The alvine discharges may consist of mucus, tenacious lymph,

or pus, as in inflammations of the mucous membrane of the canal, the nature of the secretion depending on the degree of inflammation ; or they may consist of blood poured out by the vessels of the intestines generally, by those of the large intestines exclusively, or by the enlarged veins of the rectum (piles). In tabes mesenterica they consist chiefly of ill-digested food, and in disease of the pancreas they contain an unusual quantity of fat.

844. The fæces may be white from the absence of bile ; unusually yellow from its excess ; green, as often happens in children ; dark and offensive, from the long retention of feculent matter, or from morbid secretions of the liver, dry and in rounded masses (*scybala*), sinking, instead of floating, in water, from long retention. They assume a light yellow color under the use of mercurial preparations ; a green color from the mineral acids in large doses ; preparations of iron, bismuth, and copper turn them black, as does also the admixture of blood in large quantity.

It is important to distinguish those discharges which flow from the general surface of the intestines from such as are the product of disease in the rectum. When, therefore, pus or blood is discharged with the motions, and the symptom is not promptly relieved by proper aperient medicines, the rectum should be examined for piles or fistula, or (if florid blood is poured out in considerable quantity) for a bleeding artery laid bare by ulceration.

845. We are often assisted in our diagnosis by comparing the discharges from the stomach with those from the bowels. Thus, obstinate constipation, with vomiting of feculent matter, implies mechanical obstruction, as in strangulated hernia ; while vomiting of feculent matter, mixed with imperfectly digested food (*lientery*) goes far to justify the inference that a fistulous opening exists between the stomach or beginning of the small intestines and the colon (ileo-colic fistula.)

846. (2.) The Organs of Circulation.—The most important symptom and sign of disease connected with the circulation is the pulse, which has been minutely examined in a former division (4) of this chapter ; and some indications of the state of the *capillary circulation* have also been considered when speaking of the gums, lips, and lining membrane of the mouth. Similar indications of the state of the circulation through the small vessels, and of the full or empty state of the vessels generally, are afforded by the appearance of the skin, which is pale after losses of blood in anæmia, in leucocythæmia, and in analogous states of system, universally florid in plethora, of a brighter or duskier red, in patches of greater or less extent, in the febrile, exanthemata, livid in diseases of the heart and lungs attended with imperfect aëration of the blood, and yellow in jaundice, from the retention in the blood of bile which ought to be eliminated by the liver. The languid circulation of old age is marked by dark discoloration of the skin of the legs ; and habits of intemperance often betray themselves by the appearance of the skin of the face, permanently mottled with streaks and spots of dark-red on a yellow ground. In extreme debility, such as

occurs in sea and land scurvy, and in the typhous stage of continued and remittent fevers, the small vessels often give way, and the blood is shed into the surrounding tissues. When the effusion is large, it is called an *extravasation* ; when it forms small round spots in the skin, these are called *petechiæ*. Extravasations and petechiæ do not disappear on pressure ; but the redness due to plethora, inflammation, or congestion readily disappears on pressure, but quickly returns on its removal.

847. The *veins*, by their distended and swollen state sometimes supply useful aids to diagnosis. When, for example, the sounds heard over the region of the heart lead us to infer valvular disease, but leave us in doubt as to the particular valve affected, a visible pulsation in the jugular veins accompanying each beat of the heart indicates regurgitation of the blood through the imperfectly closed *tricuspid* valve. This is called the *venous pulse*. When the pulsations are very distinct, we infer that the walls of the right ventricle are thickened. This true venous pulse must be distinguished from the lifting of a vein by the force of the artery lying beneath it. The superficial veins sometimes become greatly distended and varicose from closure, by pressure or disease, of some deeper-seated venous trunk.

848. (3.) The Organs of Respiration.—Though the number of the respirations, and the proportion they bear to the pulse, as well as the respiratory movements generally, have been minutely examined in a former part (5) of this chapter, several symptoms and signs of disease, due to disturbance in the functions of the lungs, remain to be considered The respiratory movements, for instance, of sighing, yawning, sneezing, and coughing, to which may be added the noisy inspiration known as stertor, deserve notice, as well as the changes the pulmonary secretions undergo in disease, and the odor and temperature of the breath. The signs derived from the altered character of the respiratory movements may be treated under the two heads of *noisy inspiration* and *noisy expiration*.

849. *Noisy Inspiration.*—In healthy persons the air passes into and out of the chest noiselessly ; but there are diseases which are accompanied and characterized by peculiar inspiratory sounds. A long, loud, *whooping* inspiration following the complete emptying of the lungs by a succession of violent expirations, or coughs, is the familiar indication of whooping cough ; laryngismus stridulus is recognized by the peculiar *crowing* character of the inspirations ; and croup by a similar inspiratory sound compared to the crowing of a cock. Attacks of spasmodic and humoral asthma, again, are marked by the loud wheezing or whistling which accompanies each drawing in of the breath. *Stertor*, *stertorous breathing*, or snoring, is another form of noisy inspiration, occasioned by the flapping of the soft palate when inactive, as in sound sleep, or paralyzed, as in cerebral congestion. Accordingly it is present in apoplexy, and in compression and concussion of the brain ; and is one of the group of symptoms known as *coma*. *Sighing* and *yawning* again are forms of deep and audible inspiration, which, as a general rule, indicate the previous imperfect performance of the function of respiration, from deficient nervous power, congestion of the lungs, or

a slight mechanical impediment to the complete expansion of the chest. As a general rule, sighing is expressive of emotion or intense occupation of the mind, and yawning of bodily fatigue. Yawning is also present in apoplexy, and in many nervous affections falling short of well-defined disease, and it attends the accumulation of urea in the blood. In the congestion of the lungs which follows recovery from asphyxia, after fainting fits, and during hysterical attacks, sighing and yawning are common occurrences. Among mechanical impediments inducing yawning or sighing as supplementary to the ordinary movements of respiration, tight-lacing and the accumulation of flatus in the stomach, hindering the downward movements of the diaphragm, may be specified. Another form of noisy inspiration is *hiccough.* This is due to slight spasm of the diaphragm, and is nearly allied in character to that common expression of grief, sobbing. Hiccough is often experienced to a painful degree in the act of eating, when the food is swallowed hastily. It occasionally accompanies inflammation of the diaphragm, or of those viscera, or parts of viscera (such as the liver, pancreas, duodenum, or cardiac extremity of the stomach), which are in contact with, or lie adjacent to it; and it is common in diseases of the kidney. It accompanies the feculent vomiting of strangulated hernia, and often occurs toward the termination of many acute maladies, when it must be looked upon in a very unfavorable light.

850. *Noisy Expiration.*—Sneezing and coughing are the two forms of noisy expiration, requiring notice as symptoms and signs of disease. *Sneezing* is a violent expulsion of air through the nostrils, following a deep and full inspiration. It either serves to clear the nostrils of some cause of irritation, or it marks the irritable state of the lining membrane which precedes catarrh and measles. It is a symptom of longer continuance in hay-asthma. It often attends the action of iodide of potassium. In common with other violent movements of the muscles of respiration, it may occur in hysteria. *Coughing* is a violent expiratory effort by which the air-passages are freed from offending matters, as the nostrils by sneezing. The contents of the air-tubes thus expelled are said to be *expectorated,* and the act of expulsion is called *expectoration.* The matters themselves are known as *sputa.*

851. There are many different kinds of cough. A cough may be *dry* or unattended by expectoration; or *moist,* being accompanied by *sputa.* The dry cough may be due to irritation of the pulmonary branches of the pneumogastric nerve, or to the pressure of tumors and morbid growths on some part of the air-passages. Hence a dry, persistent, ringing cough will sometimes indicate aneurism of the aorta. A dry cough is also present in the early stage of inflammation of the air-tubes, when the blood-vessels are in a state of fulness unfavorable to secretion. This happens at the onset of attacks of catarrh, influenza, and croup, and in the first stage of humoral asthma. A dry cough is also one of the results of dyspepsia, of obstinate constipation, and of intestinal worms; and a loud, dry, barking cough is recognized as a symptom of hysteria. The cough in incipient

phthisis is either dry or attended with scanty expectoration. An inflamed state of the fauces with enlarged tonsils and relaxed uvula is another cause of a dry cough. Inflammation or ulceration of the larynx and trachea also gives rise to a troublesome dry cough, or one attended with very scanty expectoration. When the seat of the disease is the upper part of the larynx, the dry cough is accompanied by a hoarse voice. A short, dry cough, attended with acute pain in the side, is one of the symptoms of pleurisy. A dry cough coming on in paroxysms is called a *spasmodic* cough, and may be often traced to inflammation of the liver, to biliary obstruction, or to disease of some viscus situate near the diaphragm. But coughs accompanied by free expectoration, when occurring in paroxysms, are also termed spasmodic. A *moist* cough is more common than a dry cough. Such a cough is present in catarrh, in bronchitis, in advanced phthisis, in whooping-cough, in pneumonia and in gangrene of the lungs.

852. The *Expectoration*, or *Sputa.*—The matters coughed up from the lungs often furnish important information; but to interpret them aright, we must bear in mind that substances spit out, or otherwise voided from the mouth, may consist of the secretions of the mouth and throat, or of the nostrils, or lungs, as well as of the secretions and contents of the stomach; and it is not always easy to determine, from the description of a patient, which of these parts has supplied the matters submitted to inspection. When, for instance, the fluid consists wholly or chiefly of blood in large quantity, it is not always easy to ascertain whether it came from the lungs by an almost imperceptible cough, or from the stomach by an easy act of vomiting; when, on the contrary, the quantity of blood in the sputa is small, it may be difficult to determine whether it was hawked from the throat or coughed from the lungs. Young children generally swallow expectorated matters.

853. Having ascertained that the matters submitted to examination come from the lungs, we should consider their quantity, both absolutely, and relatively to the time occupied in their discharge, as well as their quality. As a general rule, a continuous and abundant expectoration, especially if coughed up with ease, may be regarded as favorable, as far, at least, as the present state of the patient is concerned. Such an expectoration exists in the moist stage of common colds, in chronic bronchitis, in confirmed phthisis, and in whooping-cough.

854. On the other hand, a scanty expectoration ushers in all acute attacks of disease of the lungs, though it also exists in the first stage of a common cold, and throughout the incipient state of pulmonary consumption. It marks the first onset of a fit of humoral asthma, and the first stage of pneumonia. Again, a transition from a scanty to a more abundant secretion may be looked upon as a favorable symptom, just as the reverse indicates a relapse or increase of disease. When a scanty secretion, coughed up with difficulty, is streaked with blood, it may be taken as evidence of great congestion, or active inflammation of the lungs. Again, a copious sputum brought up in one act or fit of coughing has a significance of its

own. It shows either a previous accumulation of the discharged matter in some cavity of the lungs, or in some neighboring viscus, or a very rapid outpouring of the same from a considerable extent of mucous membrane of the lung itself.

855. The character of the sputa often supplies an important aid to diagnosis; the changes which occur in the course of the same illness being specially deserving of attention. The sputa may consist of unmixed mucus of various degrees of consistence (as in catarrh, bronchitis, and pneumonia); of a thin watery mucus (in some cases of early phthisis); of a tenacious, gelatinous mucus, mottled with small, round, brown, or black spots, and full of air-bubbles (in humoral asthma immediately following the dry stage); of a stringy tenacious brown or rust-colored mucus (in the first stage of pneumonia); of mucus tinged or streaked with dark blood (in the acme of a fit of humoral asthma, in acute pneumonia, and in some cases of phthisis pulmonalis); of mucus blended with pus (in fully developed catarrh, in bronchitis, and in confirmed phthisis). Again, the expectorated matters may be wholly or chiefly *purulent*, the contents of a cavity suddenly or gradually discharged, or of the sac of the pleura communicating with the lung by a fistulous opening; or of an abscess in the liver, in this case deeply tinged with bile. The sputa have sometimes an extremely offensive odor, arising from the decomposition of the retained secretions, or from gangrenous destruction of the lung tissue. Expectoration of *blood*, often in large quantity, is a common occurrence in disease of the heart and lungs.

856. *Spitting of Blood.*—There are few cases of pulmonary consumption in which this symptom does not happen; and it always furnishes a strong presumption in favor of the existence of that disease. A scanty expectoration of blood may, however, occur in pneumonia, in acute bronchitis, and in the fit of asthma; and a copious and rapid discharge of blood by coughing in the rare disease known as fibrous bronchitis, and in aneurismal tumors communicating with the air-passages, as well as in phthisis. The color of the blood, the matters with which, if not pure, it is mixed, and the mode of its discharge should always be carefully inquired into, as it may be of great importance to distinguish copious hemorrhage from the lungs in hæmoptysis from equally copious discharges of blood in hæmatemesis.

Fig. 52.

857. A microscopical examination of the sputa may aid the diagnosis in cases where the symptoms are obscure. When the sputa are of such consistence as to allow of it, they should be washed lightly in water, to remove extraneous matters coming from the mouth. Small portions of the mass may then be covered by thin glass and examined. In this way we may recognize the fibres of the elastic tissue of the air-cells (Fig. 52.), indicating a destruction of the substance of the lung, as in phthisis and gangrene; casts of the minute air-tubes, as in pneumonia and fibrous bronchitis; and the small granular matter of tubercle in phthisis. The sputa in this disease are frequently found to be

made up of semi-transparent, round, oval, or triangular spots, consisting of small granular cells (*tubercle corpuscles*), mixed with free granules and oil-globules. Sometimes, also, they contain fragments of mixed phosphate and carbonate of lime, which effervesce on the addition of an acid.

858. (4.) THE URINARY AND GENITAL ORGANS.—The urine itself has been minutely examined in a previous section of this chapter. The indications afforded by the mode of passing the urine remain to be considered. It may be voided with difficulty (dysuria), and the difficulty may be attended by acute suffering at the neck of the bladder (strangury). The slighter degrees of dysuria are sometimes caused by pressure, or by irritation, propagated from a neighboring organ, the rectum, when loaded with fæces, or worms. Enlargement of the womb, as in advanced pregnancy, or irritation of the vagina, as in acute gonorrhœa, may cause the same symptoms in the female. Inflammatory affections of the rectum, such as dysentery, will also occasion it; and the irritant poisons cause it, partly by the inflammation set up in the rectum, partly by the irritating quality imparted to the urine. Two poisons especially, cantharides and turpentine, possess the property of inflaming the whole urinary system, and exciting strangury, with painful erections of the penis in the male, and excitement of the genital organs in the female. Frequent and painful micturition may also be occasioned by a highly acid state of the urine, and by gravel. Affections of the bladder itself, such as inflammation (the offspring sometimes of catarrh sometimes of gonorrhœa extending from the urethra), ulceration, spasm, and fungus growths, may give rise to the same symptom; or it may be traced to similar affections of the urethra, to stricture, to enlargement of the prostate, or to the passage of calculi.

859. *Retention of urine*, from an obstacle to the discharge of the urine actually secreted, must be distinguished from *suppression of urine* (ischuria), the effect of disease of the kidney arresting the secretion. Retention of urine may result from continued over-distention of the bladder, exhausting the power of the muscular coat; from disease of the spinal cord paralyizing it; or from loss of sensibility through cerebral disease, or extreme functional disorder of the nervous centres, as in continued fever and in typhous states of the system. Spasm of the neck of the bladder is another cause of retention. It sometimes occurs in hysteria. In many cases the cause of retention is mechanical. The seat of the obstruction may be in the ureter (as in the passage of a calculus from the kidney), in the bladder itself, or in the canal of the urethra, from enlargement of the middle lobe of the prostate, or from the pressure of a tumor external to the canal.

860. *Suppression of urine* (Ischuria renalis) means a cessation of the secretion of the kidneys. This may occur in idiopathic inflammation of the kidney, or as the result of inflammation produced by irritant poisons, especially cantharides and corrosive sublimate. It may also occur after scarlet fever; and it is a symptom of Asiatic cholera. Extreme congestion of the kidney may also occasion it. The effect of prolonged suppression is great drowsiness, passing gradually into coma.

861. The *sexual organs of the male* occasionally furnish useful indications. A troublesome irritation of the glans penis and prepuce, with frequent erections (priapism), characterizes stone in the bladder. Erections, without irritation of the extremity of the organ, also occur from congestion of the kidney, from irritation at the neck of the bladder, and from inflammation of the canal of the urethra. Painful erections, with curvature of the organ, constitute the most troublesome symptom of gonorrhœa. Priapism is also a leading symptom of poisoning by cantharides and turpentine, and of other active poisons of the irritant class. Erection of the penis, with discharge of urine or other fluid, and expulsion of fæces, is also a not uncommon occurrence in death by hanging and decapitation, in poisoning by prussic acid, in other forms of violent and sudden death, and in the epileptic fit.

862. The *sexual organs of the female* are subject to many diseases, some of which deserve notice as symptoms or concomitants of other disorders. Anæmia, for instance, is often accompanied by amenorrhœa, as is the opposite state of plethora, though less frequently. Certain mental disorders, again, especially some forms of mania, and some varieties of monomania, are found associated with amenorrhœa, dysmenorrhœa, or the change of life. The importance attached to the menstrual function by patients, and the occasional association of disorders of menstruation with constitutional disturbance, and especially with hysteria, render it expedient for the medical man to inquire into the state of this function in all cases that come under his care. The suppression of the menstrual discharge, the enlargement of the breasts, with the darkened and otherwise altered appearance of the areola, the change in the shape and size of the abdomen, and certain changes in the uterus itself, have great importance as signs of pregnancy.

863. (5.) THE NERVOUS SYSTEM.—The symptoms and signs of disease which have to be treated under this head consists of, *a*, altered sensation; *b*, altered muscular action; and *c*, altered mental phenomena.

864. (*a.*) *Altered Sensation.*—All the organs of sense may suffer in three ways; the sensation of which they are the seat may be blunted or lost, heightened or perverted. The muscles also, and those viscera which are not organs of sense, and in health perform their functions unconsciously, may become, through disease, highly sensitive, and the seats of acute pain. Again, all parts of the body, whether endowed with sensibility or not, may manifest pain on pressure, or forcible extension.

865. *Pain.*—In estimating the value of pain as a symptom of disease, we have to consider its degree, its character, its seat, its extent, its duration, its persistence or otherwise, and its concomitants. In estimating the *degree* of pain, it is necessary to bear in mind the difference of expression used by patients in describing it, according as they have more or less general sensibility, more or less fortitude, and more or less honesty. The lesser degrees of pain are usually spoken of as slight, moderate, bearable; the greater degrees as acute, intense, severe, violent, excruciating, agonizing, distracting, intolerable. The only general principle of practical im-

portance which can be laid down in respect of degrees of pain is, that the most acute is often occasioned by causes that entail the least danger to life; while the lesser degrees are often present in diseases of far more formidable character. It should also be borne in mind that there are states of system, such as hysteria, which exaggerate pain, and others, such as lethargy and the typhous state, which blunt it.

866. The *character*, like the degree, of pain is subject to considerable variety, and assists us in tracing it to its source, and assigning its true cause. A *dull, obtuse, aching* pain is common in congestions and subacute inflammations, and even in acute inflammations of soft and yielding parts. There is a dull, aching pain in the right side in congestion of the liver, in the loins in congestion of the kidney, and in the head, back, and limbs, at the onset of severe febrile attacks. A higher degree of this pain is present in periostitis, rheumatism, gout, and the milder forms of neuralgia, when it is distinguished as a *gnawing* pain. A *burning* pain is often present in severe inflammation, as a combined result of heat and tension. A *throbbing* pain is present in inflamed parts subject to pressure, as in whitlow, and also in all abscesses similarly circumstanced. Pain in parts of the intestinal canal is commonly described as *griping* or *twisting*. In scirrhous tumors, and in neuralgia, the pain is designated as *shooting, cutting, darting, lancinating.*

867. The *seat* of pain may afford useful indications by corresponding with the diseased part or organ which occasions it, or by the part affected with pain being in connection with the immediate seat of the disease by the intervention of nerves more or less directly traceable from the one to the other. Thus, disease of the hip-joint occasions pain in the knee; stone in the bladder, pain in the glans penis (in the female, pain at the meatus urinarius); inflammation of the kidney and calculus in the ureter, cause pain in the groin, thigh, and testicle; disease of the womb, pain in the loins; constipation, pain down the back of the thigh; inflammation of the liver, pain in the right shoulder; and disease of the heart, pain in the left arm, or down to the bend of both arms. Leucorrhœal discharges, and all causes of debility in nervous and irritable females, give rise to pain in the left side; to a tender state of the spinal cord; to superficial thoracic and abdominal pains; and irritation at the root of a sensitive nerve, to pain in all the parts to which its branches are distributed. Some of these pains are called *sympathetic*.

868. Of the *extent* of pain it may be said (as a general rule) that pain limited to one spot is more likely to indicate severe disease than pain of greater extent. The pains of muscular rheumatism are generally extensive, as are those which attack hysteric females. But, on the other hand, neuralgic pains are often limited to small spots, as the brow, or to single organs, as the testicle or mamma.

869. The *duration* of pain is a point of importance, especially when taken in connection with the general health. Pain of long continuance, not materially affecting the health, would probably be neuralgic; and in the female would probably be connected with other symptoms of hysteria.

The *persistence*, or otherwise, of pain is also well worth attention. As a general rule, the pain in important local diseases is *continuous*, though liable to exacerbations, and, under treatment, to abatement. In less important cases pains are *fugitive, wandering, shifting*. In one disease—brow-ague—the pain is *intermittent* or *remittent*.

870. The *concomitants* of pain are also highly important. As a rule, the pain of inflammation is increased by pressure, and muscular pain by motion, or by brisk percussion with the points of the fingers, while neuralgic pains are independent of these causes. The pains of colic are relieved by pressure. Neuralgic, rheumatic, and gouty pains are usually compatible with health, or with slight departures from it, while most other pains are associated with marked deviations from it.

871. *Diminishd Sensation.*—All the organs of sense may have their function blunted or lost; and as this condition sometimes furnishes important indications, it will have to be considered as it affects touch, sight, hearing, smell, and taste.

872. The *sense of touch* may be so impaired as to give rise to numbness, which may be brought about by cold, by pressure on the trunks of the nerves, or by the local action of narcotic poisons. Long-continued numbness would probably arise from pressure on the trunk of a nerve, or of some disease of the nerve itself, impairing but not destroying its function. Total loss of sensation in any part of the body would follow stronger pressure, or severe disease of the nerve or nervous centres. Loss of sensation in the arms or legs, or in the whole body, is an occasional accompaniment of muscular paralysis of the same parts. A loss of sensibility is occasionally present in hysteric females, and may be brought about by narcotics and by mesmeric manipulations. In examining patients with a view to determine the presence or absence of sensibility, it should be borne in mind that strong muscular contractions may follow irritation of the skin from reflex action, in the absence of sensation.

873. The *sense of sight* is variously affected, not merely from local causes attacking the organ itself, but also from disordered and diseased conditions of the brain. Slight and transient affections of the sight are common in dyspepsia, and in slight febrile and other disturbances of the circulation. These affections consist in dark spots (muscæ volitantes), bright spots, sparks, or brilliant colors (as seen by persons drowning or hanging), or in simple indistinctness of vision, in a flickering motion, in a double vision, as in the drunkard, or in a half vision of objects.

Illusions have already been considered at p. 100. A heightened sensibility of the retina, accompanied by a dread of light (photophobia), is a common symptom of acute inflammations of the eye itself, and of inflammatory affections of the brain. It may also be present in acute anæmia from loss of blood, and in the hysteria of weak and delicate females. The opposite state of permanently diminished sensibility of the retina is usually connected with disease of the optic nerve, or of that part of the base of the brain from which the nerve arises. Transient dimness of vision, or

actual blindness, sometimes occurs from loss of blood, from excessive lactation, or from other exhausting discharges, and it commonly precedes the fainting state.

874. *Squinting*, when not permanent, is often due to affections of the brain, and is an unfavorable symptom. It is common in children with disease of the brain attended by convulsions; and the permanent squint of the adult is often traceable to this cause.

875. The state of the *pupil* is highly deserving of attention. As a general rule it is contracted in irritation of the brain, whether due to inflammation of the organ or not, and the contraction is extreme in poisoning by opium and the Calabar bean. On the other hand, the pupil is apt to be dilated in congestion of the brain without irritation, in hydrocephalus, in epilepsy, in some cases and stages of apoplexy, and in functional disorders due to remote causes, such as constipation and intestinal worms. It is also dilated in poisoning by belladonna, hyoscyamus, and stramonium, and by some other poisons belonging to the class of narcotico-acrids, as well as by the local application of the more active members of this class. The condition of the pupil is also an indication of the state of the retina. If it contracts freely under the stimulus of light, the retina has not lost its sensibility; if not, there is a loss of sensibility in the nerve, and, in certain cases, in the entire nervous system. When, in the absence of disease of the eye itself, the pupil of one eye is dilated while that of the other is contracted, cerebral disease may be presumed to be present. The state of the surface of the eye is used as a test of the condition of the nervous system. If insensible to the touch, the nervous system generally may be assumed to be in the same state. It is so under the full influence of chloroform, and in epilepsy, but in the malingerer it, of course, responds to the touch.

876. The *sense of hearing* is subject to analogous affections with the sense of sight—to ringing sounds (tinnitus aurium), to distinct musical notes, and to puffing sounds like the noise of a locomotive. These may occur from slight and transient causes, and need not excite apprehension. But they may also usher in chronic or acute diseases of the brain. Of more marked illusions of the sense of hearing, something has been said at p. 100. The sense of hearing is generally acutely painful in inflammation of the brain; and, in common with the sight, in the opposite state of the cerebral circulation; also in some cases of hysteria. *Deafness* is common in fever and in the febrile exanthemata. In some instances it is associated with cerebral disease, and forms one of the group of symptoms by which it may be recognized.

877. The *sense of smell* is subject to illusions similar to those that affect the eye and ear; but the disorders of this sense have little significance as signs of disease.

The *sense of taste* has been already considered in § 495.

878. *(b.) Altered Muscular Action.*—The muscles are subject to paralysis, to convulsion, and to spasm. *Paralysis* may be local or general, of

greater or less extent. It may affect the muscles of the tongue, or the muscles of the upper eyelid (causing ptosis), or several of the muscles of the eyeball (causing strabismus), or the muscles supplied by the facial nerve (causing palsy of one side of the face), or the muscles of one arm or one leg, or the muscles of one side of the body (hemiplegia), or the muscles of the lower half of the body (paraplegia). The loss of power may also vary in degree, being complete or incomplete. The cause of local paralysis may be either pressure in the course of the nerve supplying the palsied part, or disease of the spinal cord. As a general rule, paraplegia may be traced to injury or disease of the spinal cord, and hemiplegia to disease of one hemisphere of the brain. A local and limited palsy, traced to a nerve issuing from the base of the skull, becomes an important indication of cerebral disease, if accompanied by palsy of some part supplied by a nerve issuing from another foramen.

879. In reference to *convulsive actions*, some distinctions worth bearing in mind are referred to at § 444. The most important to observe at the bedside are the twitchings (*subsultus tendinum*), the picking at the bedclothes (*floccitatio*), and the tremulous protrusion of the tongue in low fever. These symptoms only occur in cases which combine prostration with excitement of the nervous system; and they are highly unfavorable. Convulsions are also common in infancy and childhood, and may be brought on by the irritation of teething, constipation, or worms; and they are present in hydrocephalus, in uræmia, and in poisoning by strychnia and other substances. In children they show themselves in the form of chorea or epilepsy; in adults in epilepsy, hysteria, and delirium tremens. They may occur on one side of the body, while the other is palsied. In sudden death from violence, or from active poisons, such as prussic acid, general convulsions, attended, as in epileptic fits, by expulsion of urine and fæces, precede the event.

880. *Spasms of the muscles*, or prolonged and rigid contraction, occur in tetanus and hydrophobia; and in some forms of hysteria. They are characteristic of poisoning by strychnia, are produced by some of the opium-alkaloids, and are occasionally observed in poisoning by all the more active poisons, both organic and inorganic. Rigid contractions of single muscles, or of groups of muscles, of long continuance, attend organic disease of the brain, and constitute a very formidable symptom. Strabismus is the result of contraction of a single muscle.

881. (*c.*) *Altered Mental Phenomena.*—These have been already treated of in a former chapter (p. 106); it only remains in this place to speak of that condition known as coma. *Coma* is a state of complete insensibility and loss of motive power. It may arise from several causes: from apoplexy; from such poisons as opium and carbonic acid gas; from drunkenness; from the operation of intense cold; from poisoning of the blood, as in uræmia; and from accumulation of serum in or on the brain. In distinguishing the coma of drunkenness from that of apoplexy we are assisted by the odor of the breath.

882. (6.) THE TEMPERATURE OF THE BODY.—The use of the thermometer from day to day may furnish useful indications, both by coinciding with, and by somewhat anticipating, changes in the circulation as indicated by the pulse. The main facts relating to this topic are stated at p. 92.

882*. In the course of an attack, either of fever or severe local inflammation of any part of the body, the physician who used to be satisfied with judging of the heat of the body by his sense of touch, now seeks for more accurate information by the aid of the thermometer, and by its means follows from day to day, from morning to night, or even, in critical cases, at shorter intervals, the rising or falling temperature.

882**. For this purpose he makes use of a small and delicate instrument requiring preliminary adjustment and careful noting of results. He begins by bringing the register into contact with the surface of the mercury, and then places the instrument under the tongue, causing the patient's mouth to be closed upon it; or, what is better, and has the advantage of being more readily applied in all cases, he makes use of the armpit. Having first caused the body to be well covered by the bedclothes, he places the thermometer in the axilla, and draws the arm of the patient across the chest, so as to keep the bulb on both sides in close contact with the skin. This should be quickly done under the bedclothes, or with the shortest possible exposure to cold. After an interval of five minutes, during which the examination of the patient may be continued, the result may be ascertained. Unless an inconveniently long instrument be used, there is some difficulty in reading the register, and it may be well to employ an instrument in which arrangements are made for magnifying the figures; or a pocket lens should be carried for the purpose.

883. (7.) THE EXPRESSION OF THE FACE AND CONDITION AND ATTITUDE OF THE BODY.—*The expression and aspect of the countenance* often afford great assistance in diagnosis, but it is not easy to convey by words a just idea of the physiognomy of disease. The varieties of mental disease are strongly marked in the face. The wild excitement of mania, the deep despondency of melancholia, the vacant look of the idiot, imbecile, and demented, are familiar to all observers. Patients with delirium tremens have often an air of extreme suspicion, and the habitual epileptic has a physiognomy of his own. Again phthisis, emphysema, organic disease of the heart, diabetes, and Bright's disease, betray themselves to the experienced physician by the expression of the countenance; cancerous disorders often reveal themselves by the peculiar color of the skin, as does the disease to which Dr. Addison's name has been given; and hysteria is often detected by rapid transitions from tears to smiles, and by an appearance of health inconsistent with the complaints of the patient.

884. *The condition of the body* in respect of nutrition always claims the attention of the physician. Rapid loss of flesh, or sudden corpulency, should equally excite attention. The one is common in such maladies as pulmonary consumption, diabetes, and organic disease of the stomach, as well as in diseases attended by profuse discharges; also in the decay of

aged persons; the other may follow recovery from pulmonary consumption, or precede attacks of apoplexy. But corpulency in the healthy may be due to inactivity or indolence. The moist or dry state of the skin is a symptom of some importance. The conditions which determine it are set forth at p. 47.

885. *The posture of the body* is often highly characteristic. It betrays loss of power in the paralytic, and weakness in the exhausted. The last stage of fever and of all exhausting maladies is marked by the helpless posture on the back; and lying on the side, as in healthy sleep, often affords an early and most welcome sign of commencing recovery from fever. The sitting or semi-recumbent posture, with the head raised by pillows, is highly characteristic of diseases directly or indirectly affecting the breathing, such as severe diseases of the lungs, and advanced diseases of the heart. The recumbent posture, with the legs drawn up, is equally characteristic of painful diseases of the abdominal viscera. In diseases of the chest we should note on which side the patient lies with most ease and comfort. As a general rule he lies on the diseased side, but the choice of position is determined in one case by a sense of pressure, in another by a sense of dragging, in a third by the ease with which the fluids gravitate to the air-tubes, and in many cases by several conditions combined. In painful diseases of the abdominal viscera, the patient, as a general rule, lies easiest on the side of the disease. The inferences to be drawn from posture are less satisfactory than could be wished.

CHAPTER V.

HYGIENE.

886. In a large proportion of the cases that come under the care of the physician, it is necessary to pay attention to those circumstances which affect the general health of the patient, and to lay down rules for his guidance in matters that belong rather to the province of Hygiene than to the Practice of Physic. Indeed, it often happens that the only remedial measures which he feels called upon to prescribe consist of a change from bad to good habits of life, from an unhealthy residence or locality to a healthy one, from intense application to study or business to repose of mind and complete change of scene and occupation. In a certain class of cases, again, change of climate is the appropriate remedy, and a locality has to be chosen suited to the disease or state of health of the patient.

With this regulation of the habits and residence of their patients, the hygienic duties of the greater number of medical men terminate ; but there are duties of a larger and more comprehensive character, in the right performance of which many medical men are directly interested—some as officers to such public institutions as workhouses, prisons, schools, hospitals, and lunatic asylums ; others as officers in the army and navy, in charge of camps, barracks, ships of war, and merchant and emigrant vessels ; others, again, as district officers of health.

The subject of this chapter may, therefore, be properly treated under the two distinct heads of *private* and *public* hygiene.

1. Private Hygiene.

887. The principal matters which require to be regulated, with a view either to the preservation of health, or its restoration, are diet, exercise, clothing, condition of dwelling, place of residence, and habits of life. *Diet*, as appropriate to persons of different ages, and as applicable to particular maladies and states of system, will be treated in the next chapter.

888. *Exercise*, regulated according to the state of the patient, is an important therapeutic agent. It may be of two kinds—*active* and *passive ;* in the one the patient moves about by his own muscular effort ; in the other he is borne from place to place. Walking, running, dancing, riding, rowing, fencing, boxing, wrestling, drilling, and all gymnastic exer-

cises and active games, are of the first class; riding at foot-pace, carriage exercise, sailing, rocking, and swinging, of the second. Both kinds call the muscles into play, and promote the circulation of the blood; but in the passive form the muscles are only employed in maintaining the posture, while the circulation is quickened only by slight displacements of blood.

889. Besides the advantage of quickening the circulation, active exercises, by calling the abdominal muscles into play, promote the action of the bowels. Those exercises, too, whether active or passive, which are carried on in the open air, have the incidental advantage of supplying a purer air for respiration; and they imply a change of scene and occupation, which reacts favorably on the mind.

890. In prescribing the kind and amount of exercise, the physician must be guided by the circumstances of each particular case. In the absence of organic disease, and when the patient suffers merely from general debility brought on by overwork, intense study, or too close attention to business, the choice of an appropriate exercise must be mainly determined by his circumstances and tastes. If practicable, change of air and scene, with the exercise which travelling implies, should be insisted on; and, where the strength allows of it, walking exercise. A sea voyage is in these cases to be preferred to carriage exercise. When the patient is unable to quit the scene of his studies or business, horse exercise in the morning or evening of the day will be found most suitable; and this is especially the case with the inhabitants of large cities, who cannot readily reach the country on foot. Fencing, rowing, quoit-playing, archery, tennis, and cricket have the double advantage of bringing all the muscles of the body into play, and of compressing a great amount of exercise into a small compass of time. Archery and lawn-tennis deserve encouragement as open-air exercise, suited to persons of either sex.

891. For growing children of delicate health, exercise is of the utmost importance, and the active games of childhood may be combined with equestrian exercise and instruction in the graceful accomplishments of dancing and fencing. In these cases much anxiety is often felt respecting the developement of the chest, especially where a tendency to consumption is supposed to exist. With a view to promote this object, drilling, and the manly exercise of fencing, is strongly to be commended for young men, and the nearest approach to it for young women. It is greatly to be preferred to dumb-bells, to the clubs, or to those gymnastic exercises which consist of tedious repetitions of the same movements. Reading aloud, much insisted on by ancient medical authorities, might be revived with great advantage; but to guard against the formation of habits injurious to the free play of the lungs, a judicious teacher should be engaged. Singing, properly taught, has the same recommendation.

892. In organic disease of the lungs or heart, all strong exertion, whether active or passive, is inadmissible, and walking on level ground is the strongest exercise that can be safely prescribed. It is to be preferred to any form of passive exercise except that of the carriage or garden chair.

Violent exercises, especially rowing in races, often give rise to heart-disease in persons having every appearance of strength and vigor. Such gymnastic exercises as require prolonged and violent action of the muscles are open to the same objection.

893. On the subject of *clothing* much misapprehension exists. There is a strong tendency toward over-clothing, especially of the chest, with a view to guard against pulmonary disorders. A delicate patient is often made to wear, in the very height of summer, as many flannels and skins as would be a sufficient protection in a polar winter, and in this way the very risk of catching cold, which it is deemed so important to avoid, is incurred. The same error is committed at night when, in addition to a load of bed-clothes much exceeding what is required to preserve the proper temperature of the body, flannel is worn next the skin.

894. An opposite error is sometimes committed in very young children, under the erroneous notion of hardening them. At the other extreme of life warm clothing is highly necessary, especially in patients suffering from pulmonary affections; and great care should be taken in severe weather to keep up the temperature of the sleeping apartment throughout the night.

895. Young men who persist in wearing no covering to the chest throughout the year but the linen shirt, and refuse to wear cotton or flannel next the skin in the winter, are also in error. A thin cotton vest should be worn even in summer, especially by those who perspire freely. In hot climates cotton, in cold climates flannel, is the proper material for body-clothing. The importance of an immediate change after active exercise, or when the clothes are wet, need not be insisted on.

896. The *condition of his dwelling* is of great importance to the invalid. The points to be attended to in choosing a house, or in planning a residence, are chiefly the following:

Site and Soil.—Where there is a free choice, a gravelly or chalky soil and sloping ground are to be preferred to a clay soil and low level site. A tenacious clay soil, a rich alluvium, or a dry surface soil with water at a short distance beneath, should be avoided, but especially the flat banks of rivers or streams, or the flat base of hills, as well as marshy spots, and the neighborhood of stagnant water. The worst combination of site and soil is a flat alluvial deposit receiving the drainage of sloping grounds. Such spots are favorite haunts of continued fevers, as marshes are of agues; and good ground has been lately assigned for tracing many cases of consumption to the same cause.

Aspect.—In England a south aspect is to be preferred, especially for invalids, as being free from the extremes of heat and cold. A north aspect lacks both light and warmth; an east aspect has the advantage of the light and warmth of the morning sun, but is exposed to the cold drying winds of winter; a west aspect is open to the objection of being too hot in the after-part of the day. In houses which can have only two opposite aspects, a southeast and a northwest are to be preferred. When there is

perfect freedom of choice, a morning-room to the east, the principal sitting-room to the south, with bedrooms to the south for invalids and aged persons, and to the east for young and healthy ones, is a desirable combination. Dairies, larders, and store-rooms should be to the north.

Shelter.—Houses require shelter from the north and east; and when such shelter is not afforded by nature, it should be secured by plantations, which ought in no case to be so near the house as to obstruct the free movement of air, or to endanger its foundations by the growth of roots. To the south and west the house should be open; but large trees at a moderate distance to the west, afford a grateful shade from the heat in summer.

Water-supply.—A well, yielding clear, colorless water, and free from drainage contamination, and a tank to hold a supply of rain-water from the roof, amounting to at least ten gallons per head per diem for a month or six weeks, are great desiderata. In deep wells the water may be said to have been filtered by the strata through which it passes; but shallow wells, especially when they are sunk in compact clay soil, are little better than recipients of surface water; and when, as often happens, they are near the cesspools or drains of the house, they are liable to be contaminated. The water-supply from shallow wells is also liable to contamination from running brooks which have received sewage. Typhoid fever is sometimes the direct result of drinking this impure water, sometimes the indirect consequence of using it in such a way as to become blended with the milk supply.

Drainage.—The soil on which the house stands should be thoroughly drained, and all offensive refuse promptly removed by impervious pipes properly trapped. Water-closets should be so placed that the drains may not pass under the house; and the sewage (in the case of detached houses in the country) should be led off to a spot remote from the house, and at regular and short intervals be applied to the land. Care should also be taken to so arrange the outlet for sewage that the foul air of the drains may not be shut up or driven back into the house, and, in some cases the drains should be supplied with ventilating pipes. In erecting places of convenience out of doors, the spots chosen should not be too near the dwelling, and the barbarous custom of digging deep cesspools should be avoided, especially in light soils, and near wells and springs. The proper construction is that adopted in many northern towns. A piece of ground is rendered impervious to moisture by ramming or paving; on this the offensive matters and slops from the house are received, and the dust, with the sifted ashes from the fires, is thrown on them, through a hopper in the side. At short intervals of a fortnight, or month, the accumulated matters are removed and thrown on a compost-heap. These simple arrangements have the advantage of being both wholesome and economical. If the dust and ashes of the house prove insufficient, dry earth may be added; or the arrangement now known as the "earth closet" may be adopted from the first.

897. The preservation of dwellings from dampness is of the first importance. To accomplish this, it is not sufficient to make the roof proof against the weather; but the basement also must be attended to. The floor or pavement should be raised on dwarf walls, supplied with air-bricks, and the house should be surrounded by an area or air-drain, so that the walls may be kept from contact with the soil. These precautions are especially necessary in clay and rich alluvial soils, difficult of drainage.

898. *Light and Air.*—Rooms should be lofty and spacious, and have open fireplaces, and windows opening above and below. Staircases well lighted and aired by windows opening on them, are preferable to those lighted by skylights, even when the lights admit of being opened. Pure air, especially in the bedroom of the invalid, should be guaranteed by the open fireplace. When the rooms are spacious, no special provision for ventilation is required beyond the facility of opening doors and windows; but small sleeping-rooms require a constant provision for the renewal of the air by means of ventilators so constructed as to prevent draughts.

899. In order to preserve the health of delicate children, it is essential to provide for the free ventilation of their sleeping apartments. Overcrowding and consequent impurity of the air in such apartments is a common cause of disease in the children even of affluent persons, and a principal source of the high mortality of the children of the poor. In addition to the precautions for insuring thorough ventilation, a certain amount of space, approaching the thousand cubic feet insisted on in § 219, should be allotted to each child.

900. In cities, and even in rural districts, the external air admitted into our houses is often very far from being sweet and pure. In the country the causes of impurity are few in number, being chiefly the gases from stagnant pools, ponds, or marshes, or the effluvia from cesspools, farm-yards, stables, pigsties, or heaps of manure. The sources of impurity should always be placed at a distance from dwelling-houses; and in no case in contact with them. In large cities the sources of aërial impurity are much more numerous, and become doubly objectionable from narrow space and imperfect movement of the air. They consist in emanations from manufactures peculiar to towns, from the necessity of heaping up, at least for a short time, the dust and ashes of our houses, from the difficulty of consuming the smoke of our chimneys, and from the defects inherent in a large and complicated system of sewerage.

901. *Warming.*—This should be so effected as not to interfere with ventilation. Close stoves should, therefore, be banished from living or sleeping apartments; their use being restricted to entrance halls, staircases, and large rooms only occasionally occupied. For living and sleeping rooms the best combination is an open fireplace of sufficient size and good radiating surface, with double windows, double panes of glass, or thick plate glass. In this way (especially when the walls of the house are thick, or double) any temperature that may be desired can be economically combined with complete ventilation. This mode of insuring a

supply of warm pure air is of great importance in pulmonary diseases, especially in the bronchitis of old persons.

902. Among the *habits of life* which militate most against health, and tend to counteract the best medical treatment, the chief are sloth, luxury, dissipation, indulgence in the pleasures of the table, the abuse of spirituous liquors, opium, and tobacco, irregularity in the time of taking meals and rest, and want of personal cleanliness.

903. For those whose constitutions have been undermined by sloth, luxury, and dissipation (Chap. 1, § 83), travelling, and the wholesome observances of fashionable baths and watering-places—early rising, regular hours for meals and exercise, the frequent use of baths, and cheerful and congenial society—are the only remedies which we have it in our power to prescribe. As intemperance and indulgence in the pleasures of the table are the besetting temptations of the same persons, there is, perhaps, no better way of guarding against them than by prescribing foreign travel, or a residence at well-chosen baths or watering-places.

904. When the abuse of spirituous liquors, opium, or tobacco is recognized as a cause of disease, steps should be taken to abolish these practices slowly and gradually, both on account of the greater safety of this procedure, and of the greater ease with which the patient may thus be made to lay his bad habits aside.

905. Irregularity in the time of taking meals and rest is an evil incident to the busy life of large cities, and one which we are often called upon to remedy by prescribing such improved habits as are compatible with the exigencies of the patient's business.

906. A want of personal cleanliness is more often chargeable against persons of education than might be expected. The practice of daily ablution of the whole body is observed by comparatively few; but it is one to be commended as an excellent tonic, as tending to guard against the catching of cold, and as keeping the pores of the skin open. The warm bath should be occasionally employed to insure a more perfect cleansing of the skin. The practice of daily ablution with cold water, followed by friction with a rough towel, hair gloves, or the flesh-brush, is often of great benefit to those who have an hereditary predisposition to consumption, or who have already manifested a tendency to it.

907. *Change of air or climate* is generally esteemed a most important means of preserving, improving, and restoring health. There are two classes of persons to whom it is usual to recommend the change. The one consists of invalids who suffer from no defined disease, but whose general health has been impaired by exposure to one or other of the many unwholesome influences which attend a residence in large towns (see § 69 *et seq.*); the other comprises persons suffering from some well-defined malady, such as chronic dyspepsia, chronic rheumatism, scrofula, pulmonary consumption, chronic bronchitis, and asthma.

908. To the mere invalid, who has suffered from the cares and anxieties of business, the dissipation of a town life, or the *ennui* of an idle and use-

less existence, change of climate is chiefly valuable as affording facilities for change of habits, scene, and occupation. In advising such persons, little more is required than to avoid climates positively unhealthy, and to make choice of countries or places which offer the greatest facilities for change of habits and occupation ; and in the case of the victim of *ennui*, the greatest inducements to exertion of mind and body.

909. In advising patients suffering from actual disease, a more exact knowledge of climate is needed, at the same time that considerations of personal convenience will have to be carefully weighed. Assuming that there are no circumstances peculiar to the patient to render a change inexpedient, the medical man will have first to consider the kind of climate best adapted to his disease, and then to select from a number of places having the required climate the one which is, on the whole, to be preferred.

910. In making choice of a climate, we may either consider the state of the patient's system, without reference to his disease, or we may be guided solely by the nature of his malady. The state of system may be either one of relaxation, characterized, if the disease affect any of the mucous membranes, by excessive secretion ; if the glandular system, by indolent swellings or ulcers ; if the skin, by chronic cutaneous affections ; if the locomotive system, by chronic rheumatism and atonic gout. A cold skin, and weak, perhaps infrequent, pulse, with general languor of all the functions, characterize this state. On the other hand, the state of system may be one of irritation, with a dry state of the mucous membranes, a harsh dry skin, and a frequent quick pulse, with a tendency to more acute forms of inflammation. In the state of relaxation, a dry bracing climate is indicated ; in the state of irritation, a mild moist one. In both, it is important to avoid a great increase of temperature, as tending to exhaustion ; sudden changes, as giving rise to cold and slight febrile attacks, and the east and northeast winds, as shown by experience to be peculiarly trying to the invalid. In chronic rheumatism, gout, and calculous disorders, a higher temperature appears to be advantageous. The climate of the East and West Indies, of the Cape of Good Hope, and of Egypt and Algiers, is deemed suitable to this class of invalids.

911. As a general rule, the bracing spots adapted to a state of relaxation are those which are elevated, scantily wooded, exposed to the prevailing winds, and consisting of a gravelly or chalky soil ; on the other hand, the mild moist climates are to be found in low situations, on clay soils, wooded, and partially or wholly uncultivated, and sheltered from the prevailing winds. As a general rule, too, the climate of the sea-shore is milder and more uniform than that of the interior, being warmer in winter and cooler in summer. Watering-places have also the twofold advantages of pure sea-breezes and of sea-bathing.

912. Bearing these considerations in mind, it will be easy to point out among the common resorts of the invalid, the places in England and abroad best adapted to the two opposite states of relaxation and irritation.

913. The mild sheltered places most resorted to on the English coast,

are Undercliff, in the Isle of Wight; Hastings, Worthing, and Bournemouth, on the south coast; Dawlish, Sidmouth, Exmouth, and Salcombe, on the coast of Devon. The sheltered spots in the islands of Guernsey and Jersey; Pau in the southwest, and Hyères and Nice in the southeast of France; Mentone, Rome, and Pisa in Italy; and Malaga in the south of Spain, offer the like advantages abroad. The islands of the Northern Atlantic (Madeira, the Canaries, and the Azores) and those of the Western Atlantic (the Bermudas and Bahamas) have the same mild relaxing climate.

914. On the other hand, the mild bracing spots adapted to a state of debility and relaxation without irritation, are, in England, Brighton, on the south coast; Torquay, on the coast of Devonshire; Clifton, on the western coast; in France, Montpellier; in Italy, Naples. These places must be understood to be intended chiefly for winter residence, the summer being spent at Yarmouth, Lowestoft or Scarborough, or inland in such spots as Malvern, Cheltenham, Leamington, Tunbridge Wells, Matlock, and Buxton, in England; among the higher Pyrenees in France; or at the better situated spas of Germany.

915. The climate best adapted for residence during the entire year is perhaps that of Madeira, which to moderate fluctuations of a temperature little exceeding that of the milder parts of England, adds the advantage of a drier atmosphere, except during the autumnal rains.

916. The diseases in which change of climate may be expected to be most beneficial are emphysema, chronic bronchitis, asthma, and all those affections of the air-passages and lungs in which previous experience has shown that the patient suffers severely in winter and is comparatively well in summer. The efficacy of change of climate in pulmonary consumption is not so well established; but in the state known as tubercular cachexia (the presumed forerunner of tubercular deposit), as in other forms of cachexia, change of climate is advantageous. Whether a mild bracing or a mild relaxing climate is to be chosen must depend on the state of the system, whether it be one of languor and torpid action or one of feverish excitement.

917. There are certain states of system in which it is well to combine with change of climate the alterative effects of minute doses of saline or other substances in a state of solution; in other words, to select as the scene of the required change of climate, regimen, and occupation, some spot where access can be had to mineral waters. Such places abound both in England and on the Continent.

918. The *mineral waters* most in repute may be divided into four classes —*the saline, chalybeate, sulphurous,* and *acidulous*—to which may be added the *hot springs.* A short description of each of these classes, with the principal watering-places where they are found, will assist the physician in his choice.

(1.) *Saline Mineral Waters.*—These consist of variable quantities of the chlorides, sulphates, carbonates, and nitrates of potash, soda, lime, magnesia, and alumina, to which may be added, as of rare occurrence, free nitrogen

and free carbonic or sulphuretted hydrogen gas, the salts of iron in small quantity, with traces of phosphoric acid, iodine, and bromine. Sea-water is a concentrated form of this class of mineral waters. These waters act as gentle aperients, and are suitable for patients suffering from dyspepsia, habitual constipation, and functional derangement of the liver. The waters of Cheltenham, Leamington, Purton near Swindon, and Scarborough, in England; of Spital-on-Tweed, Pitkaithly, Airthrey, Dunblane, and Innerleithen, in Scotland; and of Ems, Carlsbad, Homburg, Seidschutz, Kreuznach, Friedrichshall, and Pülna, in Germany, belong to this class. Some of these waters contain minute quantities of iodine and bromine, and are therefore indicated in scrofulous disorders, especially when attended by glandular enlargements. The waters of Kissengen and Kreuznach contain bromide of sodium in sufficient quantity (about a fourth of a grain in a pound of water) to have some effect if taken freely and continuously. The Woodhall Spa, near Horncastle, is very much richer both in iodine and in bromine. The strongest aperient waters belonging to this class are, in England, those of Cheltenham and Leamington; in Scotland, those of Airthrey; in Germany, those of Pülna, Seidschutz, Homburg, Kreuznach, Kissengen, and Marienbad.

(2.) *Chalybeate Waters.*—These contain variable quantities of the sulphate and carbonate of iron, and are, therefore, tonics specially adapted to the treatment of anæmia, and of functional disorders of the uterus. They are slightly stimulating, and require to be combined with aperient medicines. The waters of Tunbridge Wells and Harrogate in England, of Hartfell Spa and Vicar's Brig in Scotland, of Spa and Tongres in Belgium and the Low Countries, of Passy near Paris, and of Rennes in the South of France, belong to this class.

(3.) *Sulphurous Waters.*—These abound in free sulphuretted hydrogen gas, and are prescribed in several skin diseases. The waters of Harrogate in England, of Moffat, Strathpeffer, and Rothsay in Scotland, of Enghein near Paris, of Barèges in the higher Pyrenees, of Aix and Leuk in Switzerland, and of Aix-la-Chapelle in Prussia, belong to this class.

(4.) *Acidulous Waters.*—These are characterized by the quantity of free carbonic acid they contain. They are more or less rich in saline ingredients; so that they might be placed with almost equal propriety in Class 1. They are applicable in the cases in which saline waters are found useful, but, being more stimulant, are better adapted to those that are characterized by great debility. The chief waters belonging to this class are those of Ilkeston, in Derbyshire, of Kissengen, Marienbad, Auschowitz, Eger, Pyrmont, Spa, Fachingen, Geilnau, Seltzer, and Homburg in Germany; of Pougues, Mont d'Or, and Vichy in France; and the Saratoga Congress Spring in America. The waters of Carlsbad and Ems contain comparatively small quantities of free carbonic acid. The chief acidulous waters of Germany, classed according to the quantity of carbonic acid they contain, beginning with the richest, are—Geilnau, Pyrmont, Eger, Auschowitz, Spa, Fachingen, Homburg, and Seltzer. The waters of Homburg rank first

among the waters of Germany for combined richness in salts and free carbonic acid.

(5.) *Hot Springs.*—These are useful both as baths and as internal remedies. As baths they have the advantage of containing, like sea-water, but in smaller quantity, certain saline ingredients, which act as stimulants to the surface; also, in some cases, free carbonic acid and nitrogen. Taken internally they have, according to their strength, the properties of saline waters. The principal members of this class are the waters of Matlock, Buxton, Bath, and Bristol, in England; of Carlsbad, Ems, and Weisbaden in Germany; of Baden in Switzerland; of Plombières and St. Nectaire in France.

919. The contents of some springs are such as to give them a place in more than one class, and to entitle them to compound appellations, such as *saline chalybeates*, named from their combining saline and chalybeate properties. At some favorite watering-places, both in England and on the Continent, several classes of mineral waters are found. Both Cheltenham and Leamington, for instance, have saline, chalybeate, and sulphurous waters; and Harrogate, in addition to strong and mild sulphur-waters, has its pure and its saline chalybeates.

920. There is no way in which most of the bad habits already referred to (§ 80) can be more effectually broken through than by residence at the least frequented of watering-places. Those most resorted to are unsuitable, as they combine the luxuries and temptations of large towns with the absence of those natural beauties which offer so wholesome an inducement to walking and other exercises.

2. Public Hygiene.

921. The saddest pages in the history of all nations are those that treat of the wholesale sacrifice of human life through ignorance or neglect of the simplest means of preserving health and averting disease. Such sacrifices have occurred in lying-in hospitals from insufficient space and neglect of ventilation; in foundling hospitals from the same causes, combined with absence of the mother's care and want of the infant's proper nutriment; in schools from want of space, neglect of cleanliness, and insufficient and improper food; in workhouses and prisons from the same causes, added to idleness, listlessness, and depression; in civil hospitals chiefly through want of space; in military hospitals from the same cause, added to the want of proper medical attention and nursing, and sometimes of proper food and medicine; in emigrant and transport ships, and men-of-war, from narrow space, foul air, bad water, and bad food; in armies in the field from ill-chosen encampments, bad provisions, overcrowding, neglect of cleanliness, and intemperance. Convulsions, infantile tetanus, and gangrene of the mouth; marasmus; puerperal fever; Asiatic cholera; jail fever; typhus, relapsing fever, "parish infection," and "the sickness of the house;" scurvy; diarrhœa and dysentery; ophthalmia; malignant ulcer

and hospital gangrene—have all been traced to such causes; while small-pox, plague, sweating sickness, black death, and cholera, have committed their worst ravages among men, women, and children overcrowded, and wanting one or more of the simple requisites of pure air and water, cleanliness, due shelter, efficient drainage, appropriate clothing, and wholesome and suitable food.

922. It is no disparagement to the art of healing to say that more lives have been sacrificed to neglect of the simplest means of preserving health than can have been saved by the most skilful medical and surgical treatment. It is of the first importance, therefore, that the physician should be able to recommend with authority the measures to be adopted to preserve the health of men, women, and children when of necessity congregated in large numbers. These measures might, indeed, be inferred from what has been said in this chapter on diet, exercise, clothing, condition of dwelling, place of residence, and habits of life, and, in the earlier chapters of this work, on the causes of disease; but the precepts thus laid down for individuals require to be modified in order to meet the cases of men, women, and children in the aggregate.

923. Of foundling hospitals, for the reception of infants, it is unnecessary to say more than that they are as indefensible on physical as on moral grounds, and that it would be waste of time to point out the means of reducing the mortality to which they must be subject. The same observation applies, though not with equal force, to lying-in hospitals. The danger of congregating large numbers of puerperal women within their walls can only be averted by a largeness of space and freedom of ventilation to which expense must always be a serious obstacle.

924. Of schools, it will suffice to remark that the contagious maladies to which children are subject render an observance of all the rules of health presently to be laid down for adults doubly necessary.

925. To prisons attaches the necessary drawback of confinement at an age when the desire for active employment is at its height. The same is true of the younger inmates of workhouses, and it is not to be doubted that when, to the evils of confinement in the case of the healthy, are added those of sick wards with inadequate accommodation, limited space, and a scale of expense necessarily adapted rather to the means of poorer ratepayers than to the strict necessities of the case, workhouses have always been, and must continue to be, highly destructive of life.

926. Sailors and soldiers on duty are exposed to special disadvantages; sailors to confined quarters, and close confinement in rough weather, often combined with bad water, scanty and unwholesome food, and great exposure and fatigue; soldiers, to the same evils, in nearly the same degree, and the superadded disadvantage of equal exposure to the weather, with less shelter, encampment on unhealthy spots, and prolonged occupation of badly selected sites for barracks and hospitals.

927. In treating of the means of preserving health and preventing disease among bodies of men there will have to be considered: 1. The case

of persons confined within such buildings as prisons, workhouses, and barracks. 2. The case of the sick in hospitals. 3. The special case of persons living for a time on board ship, as sailors or emigrants. 4. The case of sailors and soldiers in actual warfare.

928. (1.) The means of preserving the health of persons confined within such buildings as prisons and workhouses are those already described as applicable to individuals and families, with a few obvious modifications. The buildings should combine a healthy site and suitable aspect with good water-supply, thorough drainage, spacious living and sleeping rooms, facilities for oversight and inspection, and ground for exercise and wholesome labor. The parts of the structure requiring drainage should be placed on the skirts of the building, so that the drains need not be carried under the building itself; and the earth-closet may be used with advantage. The walls should be surrounded by air-drains; the lower story of the building should be raised so that the floor is not in contact with the soil; the space in living and sleeping rooms should not fall far short of the dimensions prescribed by John Howard ($10 \times 10 \times 10$ feet) and warmth and ventilation should be conjointly secured, by open fireplaces, and windows glazed with thick glass, or with double panes of common glass, and opening above and below. In prisons, warming by hot air, hot water, or steam, and ventilation by mechanical aids, cannot well be dispensed with. In all other buildings these methods are highly objectionable, except for passages and halls, and for rooms occupied only occasionally, and for short periods of time. Scrupulous cleanliness is to be insisted on, not merely for its own sake, but for the occupation it gives; facilities for exercise have not merely to be provided, but exercise itself to be organized and superintended. The diet of the inmates should consist of a due proportion of animal and vegetable substances, from which vegetables or cheap fruits containing a vegetable acid, or such an acid in combination with an alkali, should on no account be omitted. This precaution requires to be specially borne in mind when the potato, which answers this description, falls short.

929. (2.) Hospitals, in common with buildings tenanted by bodies of healthy persons, should combine a well-selected site, a dry soil, thorough drainage, a suitable aspect, a compact arrangement of rooms and passages favorable to efficient oversight and easy communication, and an economic system of warming and ventilation. The remarks already made on site, soil, and drainage, as applicable to houses, apply equally to hospitals, and a few additional words on the subject of aspect will supply all that is required on this head.

The best aspects for the wards of an hospital are north and south, or northwest and southeast. The east and west aspects have the advantage of greater cheerfulness, with the drawback of the sun's glare; and the west aspect is open in summer to the objection of great heat in the after-part of the day. The south aspect is the best for consumptive patients, for those suffering from diseases of the lungs, for weak and delicate persons, and for the aged. In hospitals restricted to two aspects, direct north and

south are preferable to direct east and west. In general hospitals with a north and south aspect, the southern wards are most suitable for diseases of the chest, for aged persons, and for the weak and delicate; the northern wards for febrile and inflammatory disorders. For convalescent hospitals, the greater cheerfulness of the east and west aspects is a recommendation. The airing-grounds should have a southern exposure. Dispensaries and rooms for the examination of patients should face north and south, and larders and provision-stores north.

The most economical arrangement of an hospital is one which devotes the basement to the out-patient department, the dispensary, the living and sleeping rooms of nurses and subordinate officers, the kitchen and stores.

A compact arrangement of rooms and passages is best obtained in a lofty building with a large central staircase: and the most economical, as well as the least objectionable, arrangement for warming and ventilating by a combination of open fireplaces with thick walls, and windows glazed with thick glass, or double panes of thin glass, and opening above and below, or tilting inward in three or more sections. The air of the central staircase should be warmed by open fires, and be available in bad weather for the ventilation of the wards.

As the wards of an hospital are occupied by sick persons day and night, the cubic contents per bed should be much larger than in prisons, workhouses, and barracks. For adult males, and in the case of hospitals in London and the large towns, it should not fall far short of 1,500 cubic feet; and in fever hospitals and lying-in wards should approach 2,000. In St. Thomas's Hospital it is upward of 1,800 cubic feet per bed in the ordinary wards, and about 2,500 in the block for infectious diseases. A considerable reduction may be made in the case of women and children, and of hospitals in open situations in small towns.

The wards of an hospital should be lofty as well as spacious, should have a height of 14, 15, or 16 feet, and such length and width as to give ample space round the beds. The beds arranged along the outer walls should stand each between two windows, and those of inner walls opposite to them, and the corner beds should not touch the end walls. The windows should rise to within a short distance of the ceiling, and open above and below. The number of beds in a ward may vary with the kind of cases admitted. In civil hospitals, thirteen or fifteen beds in a ward are convenient numbers, especially as admitting of symmetrical arrangement; in military hospitals, thirty beds is the number usually preferred. For an equal number of nurses or attendants, the number of beds in a ward will decrease with the severity of the cases, and *vice versâ*.

The same principles of arrangement and construction apply to military as to civil hospitals. For soldiers in actual service, it is important to observe that the roughest weatherproof shed, provided it be spacious, is better than the most substantial building if overcrowded. This truth, firmly established by Dr. Brocklesby, is one that ought never to be absent from the mind of the army surgeon. (See Dr. Guy's "Public Health," p. 312.)

930. (3.) A ship on the open sea has the solitary advantage of being surrounded by air free from injurious terrestrial emanations. In all other respects it is placed under unfavorable circumstances; for it combines the drawbacks of inadequate space for passengers and crew, and stowage of water and provisions; of ventilation liable to frequent interruptions; of a moist atmosphere acting on vegetable matters subject to decomposition. A ship in harbor, though in other respects better circumstanced, is often exposed to the most deleterious emanations from low swampy lands and rich alluvial soils. A seafaring life, moreover, is exposed to great and continuous fatigues under circumstances otherwise unfavorable to health, and to a certain extent, and often for long periods of time, to the evils of a monotonous existence. Hence the health of seamen and passengers by sea can only be preserved by the most watchful care and attention to the cleanliness, dryness, and ventilation of the ship, the supply of fresh water, and of sound provisions embracing all the elements of a wholesome diet, with suitable clothes, and proper change of clothing, with fitting exercise, occupation, and recreation, and facilities for separating the sick from the healthy. The precise means to be adopted to insure these ends can only be fitly described by those who add to a general knowledge of the principles of hygiene a special acquaintance with the construction and internal economy of ships.

931. (4.) The preservation of the health of soldiers and sailors in actual warfare is a subject which can only be adequately treated in works specially devoted to it. Men engaged in offensive wars are exposed at the same time, or in quick succession, to every cause of disease except inactivity of mind and body; and even from this they are not always exempt. They are often called on to serve in unhealthy climates and pestilential places, in inclement seasons, with inadequate shelter or with no shelter at all, with short supplies of provisions, rarely of the best quality, and from which some important elements of a wholesome diet are almost necessarily omitted; exposed to every species of hardship and privation, to fatigue and want of rest, and they are sometimes tempted to dangerous excesses of riot and intemperance. When serving at a distance from home, they often enter on a campaign with health impaired by the confinement of a long sea voyage, and may have to occupy garrisons and encampments combining the most unwholesome sites with the most imperfect sanitary arrangements. Under such circumstances a close attention to all the known means of preserving health and preventing disease becomes imperatively necessary. Some of the leading precautions and provisions applicable to the soldier in service may be briefly stated.

In transporting troops from place to place the same watchful care is required on board ship as in the case of sailors and passengers; and when it is possible to choose the time of year, that should be selected which will enable the soldier to arrive at his destination at the healthiest season, and one bearing the nearest resemblance to his native climate. His *clothing* should be suited to the climate and season, being of close-fitting woollen

materials in cold climates and in winter ; of cotton, sitting loose, and with protection for the head, in hot climates and in summer. In winter, flannel should be worn next the skin ; in summer, cotton. A warm waterproof cloak for wet weather and night use, and strong thick shoes well-fitted to the feet, with thick woollen socks, complete the necessary clothing of the soldier. In all places, and at all times, mere soldierly appearance and bearing should give place to comfort and practical efficiency. The best *bedding* for the soldier is a mattress stuffed with cork, covered beneath with waterproof cloth, and having a double flap of the same material to draw over the body. The soldier's *diet* should be as carefully adapted to the climate as his dress. In cold climates a full supply of animal food should be provided, and spirituous liquors are least injurious ; in warm climates an excess of vegetable food, and an abstinence from spirituous liquors, should be enjoined ; in both, vegetables and ripe fruits, or their nearest substitutes, ought on no account to be omitted. The soldier on the *march* should be in motion during the hours most suitable for exercise and for avoiding the intense heat of warm climates. He might always advantageously walk one or two miles before taking his first meal ; then, after rest and refreshment, enter on the principal portion of the day's march. The best food for the first meal is warm nutritious soup, or hot coffee with bread ; and tea is always a grateful refreshment. The ground chosen for *encampments* should, if possible, be sloping, so as to allow of natural drainage, protected from cold winds, and, in hot climates, affording the shelter of trees. Places for the deposit of offensive matters should be chosen in reference to the prevailing direction of the wind. They are best placed on a sloping bank, upon which dry earth should be thrown day by day ; the mixed soil being removed at short intervals to a convenient distance. Soldiers should not remain on the same spot for any length of time, but the site of the camp should be changed at short intervals. Proper arrangements should always be made for separating the sick from the healthy ; and, in providing tents, or huts, or more substantial buildings for hospitals, the principle already laid down should be constantly borne in mind, that the roughest shelter, with plenty of space, is preferable to the most substantial building without it.

Soldiers in *cantonments* or *barracks* often suffer through the selection of an improper site. Instead of being stationed on high sloping ground, some low-lying swamp at the mouth of a river is chosen, with the certain result of excessive sickness and a high mortality. If to this first fatal error there be added a similar neglect of other hygienic precautions, the results are lamentable. If, on the other hand, a good choice of site is followed up by careful attention to all the simple rules of health, the soldier's life may be preserved even in the unhealthiest climates.

In cantonments and barracks, and on the march, as far as the exigencies of actual warfare will permit, the following precautions should be carefully observed. The soldier should be sheltered, as much as possible, from the heat of the day, and from the cold and dews of the night ; dry,

healthy spots should be chosen for military exercises; military duties should be so timed that the soldier may be deprived as rarely as possible of his natural sleep; in mounting guard arrangements should be made to employ as few fatigue-parties as possible; the messes should be so ordered that the soldier may begin the duties of the day with a comfortable warm breakfast; the diet should always comprise a due supply of vegetables and, if possible, of ripe fruits, and the canteen should be placed under stringent regulations; the means of personal cleanliness provided, and daily washing of the feet and frequent bathing insisted on; flannel waist-coats or cotton shirts should be worn next the skin, and a flannel belt round the loins; and a change of clothing provided and ordered after every exposure to rain. The soldier should also be subject to frequent medical inspection, especially during the prevalence of epidemics; be encouraged to engage in manly sports, and employed to the utmost in useful and cheerful labors and studies.

The subject of Public Hygiene would be incomplete if some notice were not taken of the *dietaries* adapted to preserve the health of men, women, and children when brought together in large numbers. A separate section may also be advantageously devoted to the subject of purification of air, water, and animal excreta; to deodorants, disinfectants, and antiseptics.

3. Dietaries.

932. The great pestilences of former days were always preceded or attended by famine or scarcity; and a deficiency of food, or a failure of some important crop, such as the potato, has proved the immediate forerunner of the most fatal outbreaks of fever in more recent times. Moreover, the relation which scarcity of food bears to one form of fever is so marked as to have led the best modern authorities to speak of it as "Relapsing, or Famine Fever."

933. Scarcity of food, or the lack of some important element of a wholesome diet, has also given rise to many fatal maladies among soldiers in active service, and especially those engaged in the attack or defence of besieged places, as well as among seamen.

934. The same cause has also been in occasional operation in all establishments for the reception of healthy and sick persons—in schools, prisons, and workhouses, in barracks, and in hospitals; and some notable and instructive examples of the danger attending large reductions in existing dietaries, and the omission from the diet-roll of such an important element as the potato and its vegetable equivalents, have been afforded within the present century. One of the most painfully instructive of these cases occurred at Millbank Prison in 1822; and some instances on a smaller scale in other prisons still more recently.

935. The principal diseases which have been traced to scarcity of food, or to food of an improper character, are scurvy (purpura nautica and

purpura hæmorrhagica), dysentery, and diarrhœa, continued fever, and scrofula ; in infants, the diseases known as tetanus neonatorum ; and in children, marasmus. All those maladies, bodily and mental, which follow upon gradual exhaustion of strength, and impairment of constitution, are also promoted by the same cause.

936. Of the diseases just specified the one which is most certainly produced by an insufficient diet, but especially by one from which vegetables are excluded, is scurvy—a disease which fortunately marks its presence not merely by extreme weakness, but by the characteristic swollen, spongy, and bleeding gums, the pouring out of blood in circular spots (petechiæ), or in irregular blotches beneath the skin, and bleeding from the mucous surfaces.

937. In devising suitable dietaries for the inmates of public establishments, or for other bodies of persons, the following general principles applicable to all persons alike, and subject to modifications in accordance with age and sex, health and sickness, and the demands made on the strength by different conditions and occupations, may be usefully laid down, relating to :—1. The constituents of a wholesome dietary. 2. The proportions in which those constituents should be given. 3. The quantities required by adults of either sex, and by children of different ages. And 4. The variations in quantity necessitated by condition and occupation.

938. (1.) *The Constituents of a Wholesome Dietary.*—Experience has taught us the necessity of blending in the same dietary more than one kind of food ; and has warned us, in language not to be mistaken, of the danger of omitting from any dietary for any length of time that vegetable element of which, in consequence partly of its abundance and partly of the convenience with which it may be stored and kept, the potato is the best representative. By chemical analysis of the blood and animal structures, we have been taught that the body cannot be built up, nourished, and maintained in health and vigor without such mixed food as shall supply it with the nitrogenous elements of muscle and skin, the carbonaceous element of fat, and the several mineral matters which enter so largely into the composition of bone, and furnish an essential element of the nervous tissue. Chemistry has also taught us that of the excretions, some (as the exhalation from the lungs) abound in carbon, others (as the urine) in nitrogen and saline matters. On the other hand, we have been taught, by the same science, that all the elementary constituents of the blood and tissues, and all the solid and gaseous elements of the excretions, exist in the food which we consume and the air we breathe, and can be traced to them ; and, further, that it is possible to arrange all the varieties of food in two great classes, according as they contain or do not contain nitrogen (§ 167), the non-nitrogenous class subserving the function of respiration, and contributing largely to the production of heat ; the nitrogenous or plastic class employed in building up, maintaining, and repairing the tissues of the body.

939. The composition of the milk by which young animals are nour-

ished, and of the egg, which performs the same office for birds, confirms the information derived from the sources just indicated; for the solid matter of milk consists of more than a third of its weight of the nitrogenous element, casein; somewhat more than a fourth of the carbonaceous material, oil or butter; and less than half of another carbonaceous element, sugar: these, with about a hundredth of its weight of mineral substances, of which by far the larger portion is phosphate of lime, being held dissolved or suspended in about eight times their weight of water. Here we have a nitrogenous or plastic element (casein), combined with carbonaceous elements in the proportion of about one to three. In the egg, again, the nitrogenous element, albumen, in the proportion of about seven parts, is blended with oily matter (a small quantity of sugar only being present) in the proportion of five parts, these matters being mixed with about three times their weight of water.

940. It follows, then, from the teachings of experience, and the researches of the chemist, that a dietary to be *wholesome* and *nutritious* must contain a combination of nitrogenous or plastic, and non-nitrogenous or respiratory, elements, together with vegetables known to contain a free acid, or such an acid in combination with potash.

941. Now, some articles of food in common use are rich in nitrogen, others in carbon, and others, again, contain both elements blended in proportions approximating more or less closely to the actual requirements of the frame. So that it is quite possible to construct wholesome and nutritious dietaries by very different combinations of food. One diet may have milk for its chief element, another the flour of wheat or other cereal, another meat, another fish, another the potato. In India rice is the staple of diet, in Ireland the potato, in Scotland oatmeal, in England the flour of wheat, in Greenland blubber, the main constituent of which is oil.

942. For practical purposes the substances most used in the dietaries of this country may be classed as nitrogenous, carbonaceous, and mixed —the first group consisting of meat, cheese, and peas; the second of suet, bones, and molasses, rice, and the potato; and the third of milk, and the flour and meal of wheat, oats, barley, and maize. The common vegetables which contain a free acid, or an acid in union with potash, are potatoes, turnips, and carrots. Cabbage and onions have the same antiscorbutic property, but with a nitrogenous element.

943. The cheapest articles which may be readily and abundantly procured in this country are: among the nitrogenous group, shins of beef (meat and bone together for soup), buttermilk and skimmed milk, and peas; among the carbonaceous group, bones, suet, molasses, potatoes, and rice; and among the mixed group, Indian meal, barley meal, oatmeal, and wheaten flour.

944. This grouping has no pretence to scientific accuracy; for with the exception of suet and molasses, the rest consist of combinations of the nitrogenous and carbonaceous elements in different proportions, the nitro-

genous group having a larger proportion of nitrogen, the carbonaceous group of carbon, and the mixed group the two elements in proportions which peculiarly fit them to become the substantial centre or basis of a wholesome and nutritious dietary.

945. These elements of a cheap dietary are variously combined in actual practice : oatmeal mixed with water or milk into porridge ; Indian corn with milk, and suet with wheaten flour, into puddings ; shin of beef with onions, carrots, and pearl-barley, into a nutritious soup ; bread is eaten with cheese ; and the potato, in the best dietaries, forms a part of every dinner.

946 (2.) The proportions in which these, the chief constituents of a wholesome dietary, ought to be blended, have been ascertained with some approach to accuracy by a chemical comparison of the food consumed and the excreta discharged, by adult males. If Dr. Dalton's experiments on himself might be taken as a standard, it would follow that an adult healthy male ought to be supplied with articles of food containing about eleven and a half ounces of carbon and an ounce and a half of nitrogen (§ 243 et seq.). The nitrogen should, therefore, bear to the carbon the proportion of about one to seven, or one to eight. Vierordt expresses the wants of the adult frame somewhat differently. He says that an adult male, to keep in good condition, requires about four ounces of albuminous matter, nearly three of fat, and about ten and a half of amylaceous food daily. One pound of wheaten bread, one pound of potatoes, and about four ounces of meat, or its equivalent in nutritious meat, soup, or cheese, per diem, would fairly meet this requirement. If it were deemed expedient to exclude the meat element, one pound of bread, half a pound of potatoes, half a pound of oatmeal, and seven pints of milk per diem, would similarly meet the theoretical requirements of the German physiologist.

947. By very general assent it has become the practice in England to supply to paupers and prisoners a dietary consisting chiefly of bread, potatoes, and meat, soup containing meat, and gruel for breakfast. A liberal, but not excessive, diet for men not at hard work might be roughly stated to consist of about 275 ounces per week of food served in the solid form, and about fourteen pints in the liquid form ; while for men at hard labor the quantity of solid food is generally found to exceed 300 ounces per week, the liquid food being still about fourteen pints.

948. The quantities of food required by adult men and women, and by children respectively, are not easily ascertained. One obvious consideration arises out of the weight of the classes to be provided for. Thus the weight of an adult woman being about a sixth less than that of an adult man, it would be reasonable, if all other things were equal, to deduct a sixth from the dietaries of adult males, in order to adapt them to the use of adult females. But as the wear and tear of the system is less in women, the deduction may perhaps be roughly represented by a fourth of the food served in the solid form. So also, as the weight of men

or women at sixty-five or seventy years of age is about a twentieth less than the weight of adults, and their functions much less active, it would not be unreasonable to reduce the dietary of aged persons by at least a tenth.

949. The case of children offers greater difficulty; but here, too, the element of weight cannot be disregarded. A child five years old will weigh about a fourth, a child of seven about a third, and one of fourteen not much more than the half of an adult of the same sex; but as the child is growing, it is obvious that it requires a quantity of food not to be measured by the weight alone. Hence, instead of a fourth, a child of five years might require a third of the food given to the adult, a child of seven might require a half, and a young person of fourteen as much as two-thirds. Assuming the weekly diet of an adult to be 300 ounces of solid food, consisting chiefly of bread, potatoes, and meat, the solid constituents of the dietary of the Foundling hospital, as given by Pereira, would amount for children under nine years to about five-twelfths, and above nine to about seven-fifteenths. The liquid portion of the food in these dietaries for children consists very properly of milk. In adult dietaries it is used exceptionally,

950. (3.) As to the quantity of food rendered necessary by condition of life and occupation, it may suffice to observe that, *cæteris paribus*, it should be in proportion to the activity of the individual, inaction of mind and body implying a moderate allowance, and activity of mind and body a liberal supply. A liberal supply of the vegetable element, of which the potato is the most convenient representative, is specially needed in men or women who lead an inactive life within doors. It is believed, too, that convicts, in consequence partly of long confinement, and partly of the depressing effect of imprisonment, require a more liberal diet than paupers; and that convicts with long sentences must be better fed than prisoners whose term of retention is shorter. It is probable that as the depression produced by imprisonment has been overestimated, so also has the need of a more sustaining diet; and it is quite possible that an increase of the vegetable (potato) element would meet this exceptional case better than an absolute increase in the quantity of the food.

What the proper tests of a sufficient diet in the case of men, women, or children congregated in workhouses, prisons, schools, etc., should be, is a question not yet satisfactorily answered. In reference to one test—the gain or loss of weight—recent inquiries have shown that it is both fallacious and misleading, especially in the case of prisoners at hard labor, in which a very considerable loss of weight (such as 20 or 30 lbs.) has been shown to be quite consistent with a full capacity for work. For prisoners not at hard labor the test of weight may perhaps be applied with more confidence, a dietary under which, on an average, the prisoners maintain their initial weight commending itself as probably sufficient. Under the dietaries in force at our separate convict prisons, the inmates, on an average, gain somewhat in weight.

4. Deodorants, Disinfectants, and Antiseptics.

951. The medical man may have to give advice as to the choice and use of these agents in the sick-room, when it is not possible to resort to a thorough draft of air to sweep away the offensive odors emanating from the patient or his *excreta*, and in cases of fever or the febrile exanthemata, in order to render inert or harmless the contagious matters which float in the air, or attach themselves to clothing, bedding, and furniture. He will also naturally be consulted respecting the purification of air, water, and offensive refuse matters; and, if officially engaged in the prevention of disease, the direction of such works of purification will constitute no inconsiderable part of his duties.

952. In treating this subject, the chief deodorants, disinfectants, and antiseptics will first be named and classified, and then those among them which are best adapted for special purposes will be pointed out.

953. (1.) *Deodorants*, or agents which remove or destroy odors. These are—1, dry solid matters, such as charcoal, lime, earth, or ashes, which act by absorbing, or combining with, the water and gases of the odoriferous material; inodorous saline solutions, of which the acid, the base, or both, combine with some element of the gas or gases to which the material owes its offensive properties (such as permanganate of potash, chloride of zinc, perchloride of iron, nitrate of lead, sulphate of iron, and the mixed sulphates of zinc and copper); 3, chlorides of lime, potash, and soda, which yield chlorine when mixed with acids; 4, liquids giving off acid vapors which combine with the ammonia of the sulphide and other ammoniacal compounds (such as vinegar and pyroligneous acid); 5, gases, as chlorine, iodine, bromine, ozone, nitrous, and sulphurous acids, and ammonia; 6, creasote and carbolic acid. The smoke of tobacco, of coarse brown paper, of cascarilla bark, of benzoin, of juniper berries, of pastilles, etc., can only conceal offensive odors, and should not, therefore, be regarded as deodorants. 7. The vapors of burning tar or pitch, and those perhaps of the resins, generally, and the smoke of burning paper saturated with nitrate of potash, may be said to occupy an intermediate position between deodorants and disinfectants.

954. (2.) *Disinfectants*, or agents which destroy infectious matter. This class is smaller than the foregoing, and comprises only a few of its more active members; and the efficiency of some of them is rather inferred from their known chemical activity than proved experimentally; for the exact nature of infectious germs is as yet unknown. The most approved disinfectants are—*Heat*. (A temperature of 212° Fahr., applied as hot air, steam, or water, during the space of from half an hour to an hour, effectually destroys infectious matters.)—*Chemical vapors*. Among deodorants those that are most likely to answer the purpose of disinfectants also, are chlorine, bromine, and iodine, ozone, and nitrous, hydrochloric, and sulphurous acid gases.—The tar acids (carbolic, cresylic, and creasote), of which *Carbolic acid* is the most available. Sulphurous acid gas, generated

by burning sulphur, and carbolic acid more or less diluted with water, are among the best of our disinfectants.

955. (3.) *Antiseptics*, or agents which arrest or prevent fermentation and putrefaction. The most efficient members of this class are—a high or low temperature (212° and 32° Fahr.).—Sulphur-fumes and carbolic acid, creasote, iodine, ammonia, perchloride of mercury, boracic and salicylic acids.

956. In making choice of one or other of these agents in special cases, we must be guided by the character of the material to be cleansed or purified. In empty rooms or buildings, or for the cleansing of floors or walls, burning sulphur, strong solutions of carbolic acid, and the several substances which give off bleaching or corrosive acid fumes, may be freely employed; they are less applicable to rooms containing furniture. The dry deodorants—charcoal, lime, earth, ashes, and sulphate of iron,—are specially applicable to feculent discharges, as is also the permanganate of potash in solution. Water containing animal matter may be treated with a dilute solution of permanganate of potash, and water which owes its hardness to bicarbonate of lime held in solution, may be softened by the use of milk of lime. The air of sick-rooms may be purified by the vapors from moist chloride of lime, or by solutions of the permanganate of potash or carbolic acid freely exposed on cloths moistened with it. The odor of feculent matters diffused through the sick-room quickly disappears on burning coarse brown paper saturated with nitrate of potash.

On the subject of the preceding chapter, especially in what relates to Military Hygiene, the reader may consult with advantage Dr. Parkes' "Manual of Practical Hygiene." Dr. Guy's work on Public Health, referred to at p. 207, contains many illustrations from the past History of Disease in England, which may be consulted with advantage by those who desire to promote a knowledge of hygienic truths and principles.

CHAPTER VI.

GENERAL THERAPEUTICS.

957. The Science of Therapeutics treats, as the name implies, of the cure and palliation of diseases. In its widest sense, it comprises all information bearing on the knowledge of disease, and of remedies. The application of this knowledge constitutes the *Art* of healing.

958. The art of healing is beset by the same difficulties that attach to the study of disease, and by others peculiar to itself. As our imperfect acquaintance with the phenomena of health limits our knowledge of disease, so our scanty knowledge of the action of remedies on the healthy frame is an obstacle to the successful treatment of disease. But still greater obstacles result from the difficulty of instituting comparative trials of different modes of treatment in the same disease, and our ignorance of the extent to which the body, if left to itself, would repair the injuries it sustains. We cannot always leave disease to itself; hence we are ignorant to a great extent of the value of the "vis medicatrix naturæ" and we are reluctant to employ a new remedy in a disease in which an old one is used by general consent, lest an unsuccessful or fatal result should be laid to our charge.

959. To form an exact classification of remedies, or to establish broad principles of treatment, is therefore a work of great difficulty. What we know on the subject will be best explained by taking the principal functions of the body, as described in a former chapter, and showing the effect of remedies on each of them in turn. In pursuance of this plan, the following arrangement will be adopted:—

(1.) Remedies applicable to disorders of the alimentary canal, including the treatment of those of the liver, pancreas, and spleen. (§§ 142 to 187.)

(2.) Remedies which modify the composition of the blood. (§§ 188 to 215.)

(3.) Remedies which affect the organs of circulation. (§§ 256 to 353.)

(4.) Remedies which act on the tissues. (§§ 354 to 393.)

(5.) Remedies which act on the nervous system. (§§ 394 to 454.)

(6.) The duties of the nurse and the management of the sick-room.

1. General Treatment of Diseases of the Alimentary Canal.

960. *Diet.*—Disorders of the stomach require regulation as to food and the time and mode of taking it. The most common functional disorder is anorexia, or loss of appetite, attendant on almost all severe dis-

eases, especially those of an inflammatory or febrile character. It always indicates a loss of digestive power, and necessitates either entire abstinence, or a bland unirritating diet, such as barley-water, toast-water, milk-and-water, and weak tea; acidulated drinks, such as lemonade and effervescing water; and ripe juicy fruits, especially the orange and grape.

961. The *acute* form of functional disorder of the stomach requires a diet free from all matter which can irritate its tender membrane, such as gruel, arrow-root, or sago, made with or without milk, to the entire exclusion of solid matters, whether animal or vegetable. The *chronic* form requires a close attention to the time and mode of taking food, the quantity and quality of the food itself, and the state of other parts of the alimentary canal, especially the large intestines, as well as that of the liver. Complete mastication, a moderate quantity of liquid and of solid food, a sparing use of condiments, and moderate intervals between meals, are points always to be insisted on. The diet suitable to each patient is, to a certain extent, a matter of experience, and distressing symptoms (such as palpitation with an irregular or intermitting pulse) have sometimes been removed by omitting some article, such as tea, or by substituting unfermented for fermented bread.

962. In organic diseases of the stomach, nutritious unirritating food, such as strong broths, soups, and jellies, must be prescribed. When the stomach is unable to retain food, life may be prolonged by nourishing enemata; by friction of the skin with oily matters; or by local baths of warm nutritious liquids.

963. Young children require a strict regulation of the diet, an abstinence from solid food, and, in extreme cases, a recurrence to the diet of the infant at the breast, substituting for the milk of the mother, asses' milk or new milk from the cow, and administering it, if necessary, in small quantities, and at long intervals. This simple treatment, aided by the steady use of aperients when required, is often attended with the best effects, after nourishing and stimulating food, given with a view of imparting strength, has wholly failed.

964. In diabetes, saccharine and starchy food and articles which are readily converted into sugar are to be avoided. The diet, therefore, is made to consist chiefly of albuminous and oleaginous elements by the substitution of gluten bread for common bread, and the use of eggs, milk, vermicelli, macaroni, and lean flesh. But restriction of the diet in diabetes is dictated by a theory of doubtful soundness, that when we cannot attack the cause or source of the disease, we ought to render difficult or impossible the development of its leading symptom.

965. In the subjects of the oxalic diathesis, we shall have to ascertain what articles of diet aggravate the disorder, and generally it will be necessary to interdict the use of sugar, acid fruits, and fermented liquors.

966. Strict dietetic rules have sometimes to be enforced as means of inducing certain states of the system. The strength and power of endurance developed during training for the ring, are partly due to the diet

prescribed ; and the reduction of weight in the jockey is effected in part by an opposite dietetic treatment. Mr. Banting reduced his weight in one year from 202 to 156 pounds by abstinence from bread, butter, milk, sugar, potatoes, and beer ; and the diet of Millbank effected a like reduction of weight in the "Claimant," without any injury to his health.

In the practice of medicine diet plays an important part. Thus we allow a nourishing diet to the convalescent, and restrict a patient with a severe inflammatory or febrile attack to substances containing little or no nutriment ; the *antiphlogistic* diet or regimen being more or less strict, according to the severity of the disease. In the most severe cases total abstinence from food may be necessary, liquids alone being allowed to allay thirst ; in less severe cases, the patient may be restricted to a vegetable diet, as having little effect on the circulation.

967. During convalescence from acute diseases strict attention must be paid to the digestion. When the appetite returns it is apt to be voracious, and then we must carefully avoid overtaxing the digestive power, cautiously passing from sloppy food to fish and then to meat, selecting the most digestible (see § 164). It is better that the patient should hunger than that he should overfeed. As the appetite returns, the regular action of the bowels must be secured. The greatest care is required during convalescence from enteric fever.

968. In prescribing an appropriate diet, it should be borne in mind that vegetable food has little or no effect on the circulation, but that animal food acts as a stimulant ; that warm liquids excite, while cold liquids act as sedatives ; and that food affects the circulation most in the early part of the day. It is in cases of slow and unsteady convalescence, when there are some remains of local affection, when the appetite is variable, and that condition of the general system exists known as "irritation," that these facts must be applied in practice. When the patient, though weak, is free from disease, when the appetite is good, and the circulation tranquil, food may be given with less caution.

969. But there are cases in which a nourishing and even stimulating diet is necessary, though local inflammation and constitutional irritation be present, and the appetite for food is almost wanting. To this class belong exhausting discharges, and extensive injuries in course of reparation, for which we prescribe solid food of the stronger and more stimulating kind, with the nutritious and stimulant liquids, wine, ale, porter, etc. In such cases, too, the previous habits must be attended to, and the drunkard must be supplied with his accustomed stimulant.

970. Many substances which increase the appetite and stimulate the stomach are in common use as *condiments*. Of these, common salt is the only one absolutely required ; for experiment has shown that animals deprived of it soon perish, however nourishing their food in other respects ; and one of the severest punishments to which man has ever been subjected, is a diet without salt. But when the diet consists principally of vegetables, spices are to be commended, as promoting digestion.

971. Every substance possessed of irritant properties increases the vascularity of the mucous membrane, and the flow of its secretion, and stimulates the muscular coat to contraction. The rubefacients which inflame the skin, inflame the mucous membrane of the stomach too; and many substances which cannot act on the skin through the cuticle, affect the more delicate and less protected lining of the stomach. In small doses these substances increase the appetite and strengthen digestion; but in large doses they act as emetics. Thus, common salt, which in moderation is the best and safest of condiments, in large doses produces sickness, and in still larger ones is an irritant poison.

972. Medicines having a similar action on the bowels, are given as adjuncts to counteract the unpleasant effects of other drugs. Thus, we, combine mint, ginger, or cloves with saline purgatives, ammoniacum with squills, galbanum with aloes, the essential oils with aperient pills.

973. The aromatics, stomachics, carminatives, or cordials, are the remedies most frequently employed with a view of increasing the appetite, or causing the fibres of the stomach to contract. Ginger, mint, and cardamoms, alone or combined with bitters, are among the best remedies of this class.

974. *Emetics.*—Those in common use are mustard, common salt, ipecacuanha, tartar-emetic, and zinc. It is usual to promote the action of these substances by copious draughts of warm water, and by tickling the throat with a feather. Emetics are commonly prescribed merely with a view to unload the stomach; for this purpose they are often given at the outset of febrile affections. But they are also administered at intervals, with good effect, in incipient cases of phthisis pulmonalis, and in bronchitis accompanied with profuse expectoration. Emetics of common salt (three table-spoonfuls to a quart of water) have been prescribed with a view of producing reaction in the collapse of cholera.

975. The stomach becomes less sensitive to stimulants often repeated: while a more gentle stimulant loses its effect entirely by repetition. The first few doses of tartar-emetic often cause sickness; but the stomach becomes accustomed to its use, and then it no longer induces vomiting; and this is true of other irritant medicines, and of tobacco also.

976. Both condiments and emetics cause a flow of blood to the mucous membrane; cold liquids and ice have the opposite effect, and are therefore useful in acute inflammation of the stomach, or active hemorrhage from its surface.

977. The *Liver.*—The functional disorders of the *liver*, which consist in a diminished secretion of bile, are most effectually treated by small doses of mercury, or by nitro-muriatic acid. Taraxacum and podophyllin are also given to increase the biliary secretion, for which purpose the remedy last named is extremely effective. Such remedies are termed *cholagogues.*

978. The *Spleen* and *Pancreas.*—Congestion of these organs are readily relieved by abstinence, and brisk aperients. Quinine has a specific action on ague, in which disease of the spleen frequently originates.

979. *Simple Diarrhœa*, like dyspepsia, may often be removed by a farinaceous diet, from which all solid and irritating matters are excluded; and it will generally yield to a single full dose of castor-oil.

980. *Constipation*, as it arises from many causes, requires many remedies. The substances which naturally promote the action of the bowels are those innutritious matters that escape the action of the stomach; such as the cuticle and spiral vessels of vegetables, the hard covering of seeds; and the tendons and gristle of meat. When these are carefully removed in the process of cookery, constipation is apt to arise, and may often be removed by restoring some of them to the food. Thus, brown or wholemeal bread often proves an effectual laxative. Constipation also occurs in persons of sedentary habits, and disappears under active exercise.

981. The medicines that cause vomiting when taken into the stomach, as tartar-emetic, tobacco, sulphate of zinc, ipecacuanha, squills, etc., and the whole class of irritant poisons, act as purgatives when they pass into the bowels; but many of the substances which act as violent purgatives have little or no effect on the stomach.

982. Purgatives act in two ways—by promoting the secretion of the mucous membrane, and by increasing the peristaltic action of the intestines; but some act slightly in one of these ways and energetically in the other. Those that excite abundant watery discharges are called *drastic* or *hydragogue cathartics.*

983. Medicines that act on the bowels may be divided into groups or classes. There are the *laxatives* (manna, cassia, pulp, tamarinds, prunes, honey, bitartrate of potash, castor, almond, and olive oils); the *saline* or antiphlogistic aperients (sulphates of soda, potash, and magnesia); the *milder acrid* aperients (senna, rhubarb, and aloes); the *strong acrid* purgatives (as jalap, scammony, black hellebore, camboge, croton oil, colocynth, and elaterium); and, lastly, the *hepatic* purgatives (hydrargyrum c. cretâ, pilula hydrargyri, calomel, and podophyllin).

984 We choose one or other of these remedies, according to the object we have in view. If we wish simply to relieve the bowels, we prefer the compound rhubarb or colocynth pills, or a combination of aloes with rhubard or ipecacuanha; if to promote the secretions of the whole course of the intestinal canal, we use the gentle laxative; if to reduce inflammation, the saline; if to overcome obstinate constipation, the stronger purgatives; if to remove dropsical effusions, the drastic or hydragogue cathartics; and if to promote the secretion of the liver, we combine the hepatic purgatives with those adapted to fulfil other indications.

985. The choice of purgatives is not more important, however, than the mode of administration. When the bowels have been long overloaded, and especially when the local irritation has affected the nervous centres, it is important to remove the load from the intestines without increasing the mischief already existing; in other words, hypercatharsis must be carefully avoided. Here we must not only select such purgatives as effectually remove the feculent matter, but watch their operation from day to

day; and as soon as any signs of intestinal irritation make their appearance, we must withdraw our purgative, and treat the hypercatharsis by a farinaceous diet, as if it were ordinary diarrhœa.

986. In cases of extreme irritability of the stomach or bowels, we may relieve the intestines by enemata, consisting of warm water, or gruel with or without an admixture of common salt; or we may employ, in the same way, any of the ordinary aperient remedies. The shock of cold water to the abdomen, sometimes employed with advantage in cases of obstinate constipation, or the electric spark, will also produce a purgative effect.

987. Enemata containing turpentine or an essential oil, such as the oil of rue, are advantageous in the painful flatulent distention of the abdomen that occurs in many cases of fever as well as in other states of system. They are most effective when thrown into the bowels by the long elastic tube. Enemata of salt dissolved in gruel are also often administered for the removal of worms, especially of the thread-worm.

2. Remedies which Modify the Composition of the Blood.

988. All articles of food, and all poisons and medicines (even the least soluble), find their way into the blood. Those substances which enter naturally into its composition, when taken in quantities proportioned to the wants of the frame, are used in building up the fabric of the body and in the production of animal heat; but when taken in excess, they are imperfectly assimilated, and cause disturbance of the internal organs in the process of elimination. Poisons and medicines in like manner, mixing with the blood, circulate with it; and after having been thus brought into contact with the textures of the body, pass out more or less quickly with the excretions.

989. In the treatment of disordered states of system, and of diseases properly so called, we sometimes administer such articles of diet or medicine as will supply some defective element of the blood; but sometimes we purposely introduce a substance foreign to its composition, in order to destroy or counteract some injurious or poisonous material to which the diseased condition owed its origin. The substances of the first order are termed *Restoratives;* those of the second order, *Catalytics* or *Alteratives.*

990. *Restoratives.*—This class may be distributed into two kinds. (1.) Water and every description of wholesome food, when the body is suffering from the want of them. Thus water has the virtues of a medicine after long marches, in starved and wounded persons; in some forms of poisoning; in profuse discharges of blood, and in diseases accompanied by excessive secretion; and there are cases in which we limit the supply of water with advantage. A nutritious animal and vegetable diet is as medicine to the convalescent; a spare diet, chiefly vegetable, to the plethoric and gouty patient. Fresh food is curative in scurvy; fatty and oily substances of some service in phthisis; animal and vegetable matters not containing sugar, or easily converted into it, are preferred in diabetes;

sugar in a crystallized form is forbidden in the oxalic acid diathesis, and fatty matters are contra-indicated in disease of the pancreas. (2.) Those medicines, properly so called, which supply an element wanting to the blood. Such are iron and its preparations in anæmia and its allied conditions; such are alkalies and acids respectively, when the acid or alkaline reaction of the urine indicates an excess of acid or of alkali in the blood. The whole class of vegetable tonics and quinine are especially believed (see Headland on the "Action of Medicines") to act favorably in states of debility by supplying to the blood an element closely allied in composition to the *taurin* of the bile.

991. *Catalytics* or *Alteratives.*—The medicines of this class are believed to be able to destroy or neutralize certain morbid poisons existing in the blood. Mercury and iodide of potassium act thus on the syphilitic poison. Again, mercury, in an eminent degree, and the fixed alkalies in a less marked manner, possess the power of checking inflammation—a power attributed, at least in part, to their well-known property of rendering the fibrin of the blood more soluble. The nature of the change which arsenic produces in the blood is less obvious, though its efficacy is undoubted; and the same observation applies to iodine and antimony.

3. Medicines which act on the Organs of Circulation.

992. We recognize four states of circulation in healthy persons, in disease, and under the operation of medicines, of which states the character of the pulse is the best indication. 1, Increased frequency of pulse with increased force and fulness; 2, Increased frequency with diminished force and fulness; 3, Diminished frequency with increased force and fulness; 4, Diminished frequency with lessened force and fulness.

993. In health, the first state of circulation is brought about by violent exercise, by spirituous liquors, and by other stimulants; the second, by those strong mental emotions and impressions which, in excess, give rise to syncope; the third attends exhaustion and sleep; and the fourth is commonly observed in the less healthy inhabitants of large towns, and in those who lead sedentary lives.

994. In disease, the first state is present in acute inflammation or high inflammatory fever; the second, in diseases attended with extreme debility; the third, in some cases of hysteria, and in some cases and certain stages of apoplexy; and the fourth, in persons predisposed to, but not actually suffering from, pulmonary consumption, as well as in those who are recovering from fever, diphtheria, and other exhausting maladies, and exceptionally in some epidemics of fever and of the febrile exanthemata.

995. The same conditions follow the operation of remedies; the frequent, full, and strong pulse is produced by spirituous liquors, by ammonia, and by other diffusible stimulants; the frequent, small, and weak pulse by tartar-emetic, tobacco, lobelia inflata, and aconite; and the in-

frequent pulse, of varying size and force, by opium, digitalis, henbane, stramonium, and other allied remedies.

996. In the cases specified—that is to say, in health, in disease, and under the operation of remedies—supposing the several states to be produced in the same person, with the same quantity of circulating fluid in his body, it is obvious that in a given time more blood will traverse each organ in the first case ; less in the second ; a variable quantity, sometimes more, sometimes less, in the third ; and a smaller quantity in the fourth case.

997. In the first case, the quantity of blood traversing each organ is increased in two ways ; by the greater frequency of the heart's beat and the larger quantity of blood sent out at each beat ; in the second, the blood traversing each organ is diminished, because the quantity sent from the heart is lessened more than the number of beats is increased ; and in the third and fourth, the heart sends forth in the one more, in the other less, blood than compensates the lesser number of its beats.

998. The remedies which augment the frequency as well as the force of the heart's contractions are called *stimulants ;* those which augment their frequency and diminish their force *depressants ;* those which produce diminished frequency with increased or diminished force *narcotics* and *sedatives.*

999. *Stimulants.*—The state of the circulation, as indicated by the pulse, being the test and measure of the effect of remedies, those are stimulants which increase the frequency and force of the heart's contractions. In exceptional cases, however, stimulants have the reverse effect.

1000. This excited state of circulation is effected by the nervous system, whatever the part to which the stimulant is applied ; the change in the nervous centres being reflected back on the heart and blood-vessels. For instance, if brandy be taken into the stomach, the impression on its nerves is conveyed direct to the heart through the branches of the solar plexus, or to the brain and spinal cord, whence it is reflected upon the heart ; or being absorbed into the circulation, it may be applied directly to the nervous centres, or to the nerves supplying the lining membrane of the heart and blood-vessels. In the simple case of exercise, the most powerful stimulant of the healthy frame, the effect on the circulation is partly mechanical, and partly reflex.

1001. The local effects of stimulants on the healthy body are due to the increased flow of blood to all its organs. The free and rapid circulation through the lungs leads to more complete decarbonization of the blood ; the increased flow of arterial blood to the brain excites all its functions ; the impressions on the senses are more acute, the flow of ideas more rapid, volition stronger and more prompt, the passions excited, the feelings joyous ; the capillary circulation is increased ; the glandular structures pour forth their secretions ; and the functions of digestion and defecation are performed with increased vigor.

1002. But stimulants in excess paralyze the nervous system, and thus

act as depressants or narcotics. Thus excess of spirituous liquors lowers the heat of the body, and induces languor with a slow and feeble pulse. Still larger doses produce narcotism. Similar effects are produced by chloroform and the ethers. The action of belladonna and ammonia is more purely stimulant than that of either alcohol or ether.

1003. It was stated (§ 999) that increased frequency, fulness, and force of pulse is the test of the action of stimulants; but there is one case in which the test fails. It is the case of debility, without local disease, characterized by a small and frequent pulse which loses frequency and gains force under the use of stimulants. The effect of stimulants on the infrequent pulse of debility without local disease is also much less than that produced on the pulse in health—a fact easily explained by the nervous exhaustion that attends debility, and renders it dead to all impressions from within or from without. If stimulants administered in this state lower the pulse, they act favorably as tonics; if they raise it much, they do harm, imparting momentary strength, to be followed by proportionate depression.

1004. As the question whether we shall or shall not administer stimulants in certain diseased conditions is important, it may be well to describe the signs which indicate the expediency or necessity of resorting to them, as well as those which prove that we were justified in giving them. The conditions of systems which especially demand the exhibition of stimulants, are: 1. The fainting state. 2. The continuous exhaustion brought on by loss of blood, profuse discharges, prolonged abstinence, an innutritious diet, and mental or bodily fatigue. 3. The exhaustion which occurs when febrile disorders assume the typhous or adynamic type. And 4. The exhaustion that ushers in many severe diseases.

(1.) The fainting state, whether produced by sudden loss of blood; by violent or prolonged exertion; by exposure to a hot and impure atmosphere; by intense mental emotion; by the cessation of the heart's action from organic disease, or by poison, such as prussic acid, and the vapor of ether and chloroform, demands the same treatment; namely, the shock of cold water, and the diffusible stimulants, ammonia, brandy, etc.

(2.) The exhaustion brought on by loss of blood, by continuous discharges, or by any of the causes just specified—a state indicated by extreme pallor of face, skin, gums, and tongue; small, quick, and frequent, or small, frequent, and irregular pulse; hurried respiration, with frequent sighing; great nervous irritability; and, in some cases, delirium—demands the continued and persevering use of those less diffusible stimulants which combine alcohol in variable proportion with a certain quantity of nourishment, such as porter, ale, wine, and brandy, proportioned to the degree of exhaustion. It is generally expedient to combine a narcotic with the stimulant, and opium is the one usually indicated.

(3.) The exhaustion which attends continued fevers and inflammations also requires the use of stimulants. In the extreme degree of this state, marked by the position on the back, the sinking of the body toward the

foot of the bed, the picking of the bedclothes, the low muttering delirium, and the involuntary discharges, such remedies are obviously necessary. But long anterior to this stage of extreme exhaustion and collapse, stimulants may be given with the greatest advantage, though some of the symptoms may be such as to excite a doubt of the propriety of administering them: the skin may be hot and dry, the tongue coated with a dry fur, the breathing quickened, the pulse frequent and sharp, with some fulness, the countenance dusky, the eye injected with dark blood, the patient restless and delirious, his movements indicating considerable muscular strength. In this state it may become a grave practical question whether stimulants ought or ought not to be given, and our doubts can only be decided by actual experiment, and careful observation of the patient before and after the use of the stimulant. If the temperature be raised and the pulse become more frequent, harder, and sharper, the stimulant is unsuitable; but if the reverse be the result, we shall be justified in the use of the stimulant, and may repeat it. If, after an interval of a few hours, during which we have persevered in the use of stimulants, we find the pulse less frequent, slower, and softer, the tongue becoming moist, the skin cooler and moister with perspiration, the breathing deeper and slower, the countenance less dusky, the eye more clear, and the restlessness and the delirium abated, we have every reason to continue our treatment. A sign much insisted on by Dr. Stokes, as decisive of the necessity for stimulants, is the state of the heart. As it partakes of the weakness which affects the entire muscular system, its pulsations become extremely feeble, and the first sound almost imperceptible. The beneficial operation of stimulants is therefore indicated by a stronger impulse, and renewed distinctness of sound. The one condition indicates the necessity for stimuli, the other justifies their use.

(4.) The exhaustion which commonly supervenes in the advanced stages of continued fever, and in other diseases which have put on the typhous type, is sometimes present in the early stages of the same maladies. The first effect of the poison of the several infectious and contagious disorders is sometimes nearly allied to collapse. The patient is extremely weak, and faints on the slightest exertion, the countenance is pale, the surface cold, the pulse frequent, full, quick, and extremely compressible, and the respiration hurried. In this state also it may be a question whether stimulants ought to be employed, and actual experiment alone can decide the question. If the stimulant lowers the pulse and renders the breathing less frequent, we are justified in prescribing its repetition, at the same time looking out for the reaction which in most cases follows this state of depression.

1005. *Tonics.*—These remedies, as the name implies, are given in states of debility, and specially in convalescence from exhausting maladies, with a view of restoring firmness, strength, and *tone* to the entire frame. In extreme weakness, stimulants impart real strength; in other words, they become tonics. In less degrees of debility, they produce less obvious effect than on the robust and healthy. Again, stimulants in large doses become

tonics in small ones. But the class of remedies to which the term *tonics* is commonly and properly applied gradually restore the strength without stimulating the system. One class of tonics, the preparations of iron, owes its virtues to its power of supplying a deficient element of the blood. The good effects of other tonics (such as bark, and its active principle quinine) are not so readily explained.

1006. *Depressants.*—This name distinguishes a class of remedies which render the pulse frequent, small, and weak, being the exact reverse of the action of stimulants. This change in the circulation is accompanied by great prostration of strength, nausea, cold sweats, and all those symptoms which characterize approaching syncope; and it is brought about by the abstraction of blood, by the preparations of antimony, by tobacco, aconite, and the lobelia inflata, and by the less active remedies, ipecacuanha and squills.

1007. The loss of a large quantity of blood, or the rapid removal of a smaller quantity, occasions syncope, or a state approaching it; and as during this state the heart sends out a comparatively small quantity of blood, and propels it with little force, that part of inflammation which is due to increased action of the heart is removed by blood-letting.

1008. Tartar-emetic, which, next to bleeding, is most potent in *acute* inflammation, brings about the same state as is produced by bleeding, and may be occasionally employed, either alone or in combination with it, in the treatment of *acute* inflammations.

1009. As there is an exception to the rule that stimulants increase the number and force of the pulse, so is there an exception to the rule that depressants increase its number while they lessen its force. Thus, blood-letting, which belongs to the order of depressants, renders the pulse full and strong, and even increases its frequency, in certain cases of plethora, when the circulation is oppressed, and in pneumonia, when the pulmonary circulation is impeded. Again, in cases of acute inflammation with high inflammatory fever, bleeding or tartar-emetic will lessen the frequency and force of the pulse at the same time. In all these cases the *modus operandi* is the same; it appears to be different only because the circumstances vary.

1010. *Sedatives.*—These remedies differ from stimulants and depressants, inasmuch as, in lieu of increasing the frequency of the pulse, they diminish it. The true sedatives differ from the pure narcotics inasmuch as in large doses they cause delirium, while the narcotics in large doses occasion coma and apoplexy. Sleep, also, is an occasional, not a constant, effect of sedatives.

1011. Hydrocyanic acid, digitalis, and aconite, the principal remedies of this class, commonly lower the pulse. But there are states of system in which these remedies increase its frequency, just as there are states in which the effect of stimulants and depressants on the circulation is reversed. Digitalis, for example, which, in diseases accompanied by a frequent pulse, lowers it in a remarkable degree, and often much below the healthy standard, in some healthy persons and in some conditions has the reverse ac-

tion. The effects of hydrocyanic acid are more constant; but exceptions doubtless exist to the rule of its operation.

1012. *Cold* is a most powerful sedative. A moderate degree of cold applied to the surface acts as a stimulant; but when the skin is hot and dry it reduces the temperature, lowers the circulation, soothes the nervous system, and disposes to sleep. Applied to the head, in the form of cold lotion or of ice, it is a most valuable remedy in inflammatory affections of the brain; and it is of the greatest service in all inflammations and hemorrhages. Ice may be swallowed with advantage in bad cases of quinsy and scarlatina, and in hydrophobia with great relief to the symptoms. Applied locally, in the form of *douche*, cold restores the contractility of the capillary vessels, and, by preventing further effusion, allows the absorbents to remove any fluid that may have been thrown out. Intense cold is also a valuable anæsthetic, and may be employed in painful operations on superficial parts. It also acts as a narcotic, and may produce states of system difficult to distinguish from the effects of alcohol.

1013. *Narcotics.*—The action of these remedies belongs so completely to the fourth head (the action of remedies on the nervous system) that nothing need be said in this place except that their effect on the circulation is the opposite of that produced by stimulants and depressants. They lessen the frequency of the heart's action, and, to a greater extent, the respiratory movements.

1014. The remedies just examined affect the circulation primarily by their influence on the nervous centres; and secondarily, through the reflection of that influence on the heart. It remains to speak of the

1015. *Remedies which affect the Smaller Vessels: Treatment of Inflammation.*—It has been already stated that in inflammation there is diminished action (that is, diminished contractility) of the small arteries, with increased action of the heart, and that the two together keep up that dilated state of the small vessels which is the essence of inflammation. It is obvious that there are two ways in which these minute vessels may be restored to their healthy state: the first is by lessening the quantity of blood passing through them; the second by increasing their contractility. In most acute inflammations both changes have to be brought about. If the inflammation be recent, the small vessels may recover themselves on being relieved from the undue quantity of blood sent to them by the heart; and in this case the abstraction of blood, or the use of depressing remedies, will suffice. But if the inflammation be chronic, the small vessels may not recover their contractility, though the blood circulates through them in diminished quantity; and in this case we must use such remedies as restore the lost contractility of the vessels. The same treatment is required in the analogous state of congestion.

1016. *Blood-letting.*—Venesection may be necessary in the earliest stage of pneumonia, in plethoric subjects, as a means of direct relief. Acute pleurisy and other local inflammations rarely require more than local depletion, by means of leeches, or cupping instruments. A high temperature,

rapid throbbing pulse, severe orthopnœa or dyspnœa, and acute pain are indications which will lead us to select this remedy.

1017. The strong action of the heart which attends acute inflammation is absent in inflammation of the mucous membranes, unless it take on the most acute character, as in croup, or in irritant poisoning.

1018. When inflammation of the mucous membranes is very severe, especially if the affected membrane line some narrow passage apt to be filled with the secretion poured out from its surface, as in acute capillary bronchitis, and in acute nephritis, local depletion may be necessary.

1019. When the seat of inflammation is an organ of extreme delicacy, we are obliged to employ general remedies, though the disease does not affect the circulation or threaten life. Thus, in inflammation of the internal parts of the eye, the most active measures are necessary to save the organ from destruction.

1020. As a rule, then, blood-letting is only required in the earliest stage of inflammation attacking robust and plethoric persons, when it is attended by increased action of the heart; when some function essential to life is impeded; or when some delicate organ is threatened with destruction.

1021. The second indication—that of causing contraction of the small vessels—may be accomplished in various ways; *locally*, by pressure, cold, astringent applications, and the cautious use of substances which themselves cause inflammation, but act as stimulants when applied in small quantity, and for a short period; and *generally*, by remedies which, by emptying the blood-vessels, promote their contraction—such are purgatives: and another very distinct class which stimulate the muscular walls of the blood-vessels to contract. This latter class of remedies contains two kinds. The first are those like digitalis and ergot, which act directly upon involuntary muscular fibres; the second act more or less indirectly, and usually in a reflex manner. Such are astringent stimulants and irritants, as tannin, copaiba, cubebs, pepper, cantharides, turpentine, the salts of zinc, copper, and silver.

The salts of antimony, mercury, arsenic, and iodine have a threefold action; by increasing the secretions they diminish the volume of the blood, by their irritant action they promote contraction of the blood-vessels, and by a depressant influence on the sympathetic nerve, they lower the force of the heart's action.

1022. Combinations of these remedies are used with great advantage. Thus, depletion, either general or local, may be followed by purgatives, and these, again, by such general remedies as digitalis, tartar-emetic, or saline diaphoretics.

1023. If the vessels are much distended, local depletion is indicated as a preparatory measure. When the small vessels have been partially emptied, we may apply the remedies just mentioned according to the nature of the inflamed part. Pressure, properly applied, lends support to the vessels; cold acts on all the tissues of the part, on its vessels and nerves;

astringent applications cause all the textures to contract, at the same time that they gently irritate the vessels, and excite them to the performance of their proper function; while such irritants as nitrate of silver, and sulphate of zinc or copper, prove beneficial by their stimulating property.

1024. The cases in which one of these remedies is more applicable than another have been determined by long experience. Tartar-emetic is to be preferred in common, mercury and iodine in specific, inflammation. Mercury is to be preferred in cases of great urgency (such as iritis and croup), when our object is not merely to subdue inflammation, but to suspend the specific disease of which it is a part.

1025. Uva ursi, copaiba, cubebs, and black pepper are employed with advantage in inflammation of the mucous membrane of the urinary passages. They act as direct stimulants through the urine. Uva ursi is used chiefly in inflammation of the mucous membrane of the bladder; copaiba and cubebs in gonorrhœa (in which disease pepper has also been employed), and black pepper in hemorrhoids. Copaiba has been prescribed with advantage in cases of bronchitis.

1026. *Hemorrhage.*—Active hemorrhage may require the same remedies as acute inflammation; and passive hemorrhage those which are useful in some forms of chronic inflammation—viz., cold, the preparations of lead, and vegetable astringents.

1027. The treatment of *febrile affections* is governed by the same general principles as the treatment of inflammation. When free from the complication of local disease, and attended by a frequent, full, and hard pulse, depressing remedies, such as a brisk purge followed by tartar-emetic, are indicated; but in cases attended by great prostration, with a small and frequent pulse, stimulant diaphoretics are beneficial. Local disease must be treated by general or local remedies, according to the patient's strength.

1028. The process of *secretion* is one over which medicine exerts much power, directly and indirectly. The most important secretions are those of the lungs, skin, kidneys, and bowels. The aërial secretions of the lungs are not usually subjects of observation or measurement.

1029. The influence of remedies on the secretions will be best understood by selecting that of the skin as an example. When the skin is red, hot, and dry, we can excite perspiration by the application of cold; when it is pale, cold, and dry, by heat. In the one case, we diminish the size of the small vessels, and lessen the quantity of blood they contain; in the other, we increase both. In the same conditions of skin, and in the same states of system, we produce the same results by depressants and stimulants, so that, in the case of this secretion, we can produce the same effect by a local application and by an internal remedy. In both cases, the temperature favorable to sweating is intermediate between the two extremes of temperature.

1030. In extreme debility it is well known that cold sweats take place from mere relaxation of the vessels, when the temperature of the body is extremely low.

1031. Blood-letting itself in a case of inflammatory fever, will promote the flow of all the secretions, by relieving that congestion of the vessels which is the chief impediment to secretion.

1032. When, therefore, we wish to promote the secretions, and especially that from the skin, we strive to bring the circulation into that state in which secretion is possible. When the skin is hot and dry, we select a depressant, when cold, a stimulant diaphoretic, in languid states of circulation, again, we prescribe a stimulating diuretic, and a depressing one when there is strong febrile action.

1033. The remedies which promote the *absorption* of fluids thrown out into the cavities of the body, act for the most part through the general system. Of these the most powerful is blood-letting, which acts by diminishing the quantity of the circulating fluid, and when the cause of dropsy is inflammatory, by removing the inflammation. The other remedies in common use are employed with the same view. They are directed to the secreting organs, the bowels, kidneys, and skin. The increased secretion from these parts has the twofold effect of blood-letting—it lessens the quantity of the circulating fluid, and it subdues inflammation.

1034. The local means best adapted to promote absorption, are those which stimulate the parts affected, such as friction with the hand or with stimulant liniments, tincture of iodine, a jet of cold water, or electricity. These act favorably either by restoring the capillaries to their healthy state, or by stimulating the absorbents. (See § 335.)

4. Remedies Adapted to the Removal of the Solid Structures of the Body.

1035. Morbid growths, due to effusion into the cysts or meshes of an organ, as in bronchocele, or deposits of solid matter, as in gout and secondary syphilis, are more or less amenable to remedial treatment (see Alteratives). But others, such as cancer, fibrous tumors, and exostosis, are wholly unaffected by the action of medicine, and require surgical interference.

1036. Atrophy and hypertrophy are, to a great extent, under the control of medicine. The remedies applicable to a state of atrophy are exercise, friction, electricity, and, in short, all those means which increase the flow of blood to the part and promote its natural actions. Those, on the other hand, which are of use in hypertrophy are, rest, pressure, cold, local abstraction of blood, and preparations of mercury and iodine.

5. Remedies which Act on the Nervous System.

1037. As all the functions of the body are dependent on nervous influence, all active remedies must affect the nervous system. Stimulants, depressants, sedatives, narcotics, and some medicines, at least, which belong to the class of tonics, affect the circulation through the nerves ; and even

those remedies, of which the action is strictly local, act locally on the nerves, and, through them, on the vessels to which they are distributed. But there are some substances which exert so peculiar an influence on the nervous system as to demand a separate notice. In this action we recognize three marked varieties. Some produce a state of excitement in all the functions of the nervous system; others soothe the nerves, tranquillize the mind, and procure sleep; a third class act chiefly on the organs of circulation and respiration, while they derange the functions of the brain, and occasion delirium; and a fourth class depress the nervous power, and lower either the pulse and temperature, or the motor activity. The first class are known as *stimulants*, the second as *hypnotics*, the third as *narcotics*, the fourth as *sedatives*.

1038. (1.) *Stimulants.*—The mode in which these remedies affect the body, and the cases in which they may be used with advantage, have already been pointed out (§ 407 *et seq.*). But they not only affect the circulation in the manner described, but also all the functions of the brain, spinal cord, and nerves. The most active and efficient stimulants are ammonia and its carbonate, phosphorus, musk, mustard, and turpentine; to which may be added the more active and diffusible among the narcotic medicines, belladonna, alcohol, ether, and chloroform, and camphor when given in large doses, the first effect of which is stimulation. To these may be added, as special stimulants to the spinal cord and nerves of voluntary motion, the alkaloids strychnia and brucia, and the plants that contain them.

1039. (2.) *Hypnotics* or *Soporifics.*—Of these opium, and its alkaloid morphia, and chloral hydrate, are the chief, and bromide of potassium, henbane, lactucarium, the hop, and the nutmeg, the less important. These are used to relieve pain (*anodynes*); to soothe irritation (*paregorics*); or, lastly, to procure sleep (*hypnotics* or *soporifics*). Opium is both stimulant and hypnotic; hence it is admirably adapted to the state of irritation accompanied by much debility, the hypnotic principle soothing the excitement, the stimulant counteracting the debility. Sulphuretted hydrogen, carbonic acid, carbonic oxide, and cyanogen gas act also as hypnotics and sedatives.

1040. (3.) *Narcotics.*—These remedies, which occasion the mixed effects of sleep, stupor, and delirium, as their leading symptom, are sometimes subdivided into the smaller groups of *inebriants*, *soporifics*, and *deliriants*. Alcoholic liquors, chloroform and the ethers, camphor, and Indian hemp, are usually regarded as "inebriants," but in excessive doses they produce more or less delirium. Henbane, belladonna, and stramonium cause delirium as an early and prominent symptom, and these are therefore regarded as typical "deliriants."

1041. (4.) *Sedatives.*—This class comprises many substances allied in some of their properties to the narcotics. They exert a depressant action on the heart, and lower the temperature; they differ from narcotics in not producing sleep. Henbane, when given in large doses, produces

delirium ; black hellebore, veratria, and colchicum are cathartic ; ipecacuanha and squill are emetic ; aconite, tobacco, lobelia, digitalis, and hydrocyanic acid are the simplest and most powerful sedatives of the whole class, causing extreme general prostration ; conium, physostigma, and gelsemium have a simple sedative action on the centres of the voluntary, and ultimately of the involuntary, muscular system.

1042. Cold has already been mentioned more than once as a remedy of great power (§ 1012). It may produce a marked sedative effect on the nervous system, without any corresponding effect on the circulating organs. It blunts sensibility and subdues pain, and in cases of violent nervous excitement allays the irritation of the nervous system, reduces the number of the pulse, subdues the most acute pain, and infallibly procures sleep. It is also of great efficacy in the most violent paroxysms of mania.

Having indicated the chief remedies which affect the nervous system, it will be useful to speak more particularly of their action on the special functions of sensation and voluntary motion.

1043. Of the remedies which act on the *nerves of sensation*, aconite is the most powerful. It produces numbness and a tingling sensation in the parts to which it is applied. Strong hydrocyanic acid, locally applied, also causes numbness ; opium and belladonna, too, act locally on the nerves of sensation ; and chloroform is a powerful local anæsthetic, after producing, as its first effect, redness and heat of surface. But the best sedative is cold. It is sure and manageable, and, with proper precautions, may be applied whenever a sedative is indicated.

1044. Belladonna shares with hyoscyamus and stramonium the power of dilating the pupil, whether given internally or applied directly to or near the eye. Calabar bean has the opposite effect.

1045. The *nerves of voluntary motion*, and through them the muscular system, are powerfully affected by remedies in three different ways—with *paralysis, convulsions*, and *tonic spasms.*

1046. Extreme muscular debility is the familiar effect of all depressing remedies. This effect is produced by tartar-emetic among mineral, and tobacco and lobelia inflata among vegetable, poisons. Paralysis, or the extreme of muscular weakness, is produced by various poisons, as the strychnos toxifera (wooraly or woorara), and by large doses of aconite and conium, and by one metallic poison—lead.

1047. Convulsions are produced by almost all active poisons. They precede the fatal event in quick poisoning by hydrocyanic acid, and occasionally occur in poisoning by opium, arsenic, and the stronger mineral poisons.

1048. Tetanic spasms are produced by nux vomica, by St. Ignatius' bean, by the strychnos tieuté, and by the active principles strychnia and brucia. They are an occasaional effect of monkshood and of ergot taken in poisonous doses, and they are sometimes present in poisoning by the more active irritants.

1049. The muscular contractions of the uterus caused by ergot fur-

nish an example of local action on the muscular fibres, of which advantage is taken in the practice of midwifery.

1050. The treatment of diseases dependent on, or accompanied by, local affections, with reflex action of the muscles, is of much importance, especially in such diseases as tetanus and hydrophobia. In the latter disease ice has often given great relief.

1051. Many of the metallic salts, such as those of arsenic, copper, iron, silver, and zinc, appear to exert an influence on the nervous system. They act locally as irritants, and when administered in small doses, and during a considerable period, as tonics; as such they have been used with advantage in chorea and epilepsy.

6. Nursing.

1052. In nursing, attention must be given to the following particulars:—Situation of the sick-room; the room itself—its arrangements, temperature, ventilation, light, refreshment; administration of medicine and food; condition and personal comfort of the patient; his intercourse with his attendants; precautions required in cases of contagious disease.

1053. *Situation of the Sick-Room.*—When we can exercise a choice, a south, southwest, or west aspect should be preferred. In acute inflammation of the brain or eye a north aspect is best. But, in the early stage of the disease, at least, aspect must be sacrificed, if need be, to quiet.

The *room* should be spacious, lofty, lightsome, and have a chimney with a good draught. In some cases the carpet may be retained; but superfluous furniture, hangings, and articles of clothing, should be removed.

1054. The *patient's bed* should be placed with its head out of direct currents of air from door and windows, and with ready access to either side of it; it should be furnished with rollers that it may be wheeled to any part of the room, and, as a rule, should be without curtains. A calico screen may be used to intercept draughts and shut out the view of the door, and of the nurse while she is preparing food or medicine.

1055. *Temperature.*—This may range from 60° to 70° Fahr., according to the feelings of the patient, and should be kept as constant as possible. If the patient complain of cold, a hot water bottle, or cushion, or an additional blanket, or eider-down quilt, may be used.

1056. *Ventilation.*—In cold and moderately warm weather a fire should be kept constantly burning. If the external air be very cold, the fresh air may be derived through the door from the lower parts of the house; if temperate, the landing window and the bedroom door, or one of the bedroom windows, should be opened. In summer, when it is too warm for a fire, the windows should be wide open during the day, and at night be partially opened. The door may be kept ajar, and occasionally fanned to and fro to cause a freer circulation of air. Vitiation of the atmosphere of the sick-room by visitors and too many attendants must be avoided. The free combustion of gas, too, must be prohibited. Growing plants may be in-

troduced into the sick-room, as they serve both to purify and to moisten the atmosphere.

1057. *Light* should be moderated according to the feelings of the patient. If he be watchful it should occasionally be excluded during the day, advantage being taken of the times when the vigilance is least. It must be constantly excluded in cases of active inflammation of the brain or eye. Direct sunlight is rarely tolerated in acute disease, but in some chronic diseases it is both pleasing and refreshing.

1058. *Refreshment.*—Offensive odors diffused through the air may be counteracted by burning a few lavender flowers or a pastille, sprinkling eau de Cologne, or burning coarse brown paper saturated with a strong solution of nitrate of potash, dried, and kept for use. But as more effectual means, the carpet being removed, the floor should be sprinkled several times a day with a weak aqueous solution of creasote or carbolic acid; or rags wetted with the same should be suspended near the bed. In cases of infectious disease, such as fever, diphtheria, gangrene of the lungs, etc., baskets of wood charcoal should be placed under the bed and in the corners of the room, and the evacuations should be received into water containing powdered carbolated lime, or a solution of carbolic acid, sulphate of iron; or a mixture of dry earth, ashes, or powdered wood charcoal, with sulphate of iron (lb. j. to ℥ j.).

1059. *Administration of Medicine.*—Pungent medicines should be given well diluted with water, to obviate coughing and nausea. Doses should be carefully measured in a graduated medicine glass, and given without delay, especially when they contain volatile ingredients. Deposits, if any, should be well shaken up. In the intervals the bottle should be kept closely corked. As a rule, medicine should be given an hour before food. But if nutriment has to be administered frequently, the medicine must be so given as least to interfere with it; stimulants may be taken with stimulants, and tonics with food; purgatives should be given before food; hypnotics at any time.

Medicines should never for a moment be allowed to stand side by side with applications for external use, and the two ought to be kept in different places. It is best to regard liniments and lotions as poisons, and to keep them out of the way in grooved bottles, so that they may be recognized as such by the touch.

1060. *Administration of Food.*—If a patient has a distaste for food, very small quantities should be offered at a time. He may thus be induced to partake of it again and again when a larger quantity presented at once would be refused. In irritable conditions of the stomach a tablespoonful of nourishment may excite vomiting, while a teaspoonful repeated often would be retained. Strong tea and jelly may be both suitable and harmless; but together, we must remember, they form indigestible leather. The juice of oranges and grapes is generally harmless, but few things are more indigestible than the pulp, skins, and seeds. In the typhous condition, food or stimulants are needed every hour; and as the patient is well-

nigh insensible to his wants, his life depends on the close attention of the nurse.

1061. *The nurse* should be quiet, circumspect, and firm, and possess the tact only to be acquired by experience. Good eyesight is indispensable. She should set aside out of reach sedative draughts, liniments, and other external applications, keeping within easy reach only such mixtures or draughts as are required at short intervals. She should be provided with oiled silk, oiled cloth, etc., so as to prevent discomfort in the use of poultices and moist applications. She should be allowed as little discretion as possible ; written directions as to the nature and quantity of food and medicine, and the times of its administration, should be given to her, and she should be directed to make a written report accordingly, noting down the number of hours the patient has slept, the time at which any new symptom, such as pain, dyspnœa, vomiting, fits, etc., occurred ; and whether, and when, the bowels or bladder have acted. She should be directed in certain cases—such as constipation, diarrhœa, enteric fever, dysentery, hepatic disease—to set aside the evacuations in the water-closet. In severe disease a bed-pan and glass urinal should be provided for the patient's use. The urine should be occasionally preserved for examination.

She should look to the general condition of the patient and note the temperature of the body, and especially of the feet. In the typhous condition these parts may be found cold and purple, and when it may be too late to recover them from this incipient stage of gangrene. In spinal and cerebral diseases, as well as in the typhous condition, the integument over the sacrum and trochanters must be daily looked to ; and if it appear congested, lead plasters spread upon amadou or wash-leather must be applied, and the pressure obviated by a water-pillow or water-bed. The medical attendant must occasionally verify the statements of the nurse, and himself examine the condition of the hypogastric region. When a patient is placed on a water-bed, the water should be warm, and a thick layer of blankets be put between the bed and body, to allow of free exit of perspiration, and prevent chilling. If the patient complain of cold we must replace some of the cold water by hot.

1062. *Personal Comfort.*—If the patient's condition allow of it, his bed should be made every day, a couch being at hand to receive him. In cases of protracted illness it is well to provide two beds. The linen should be changed as often as it can be done without undue fatigue, and advantage should be taken of this change to administer a bath, or to sponge the skin with warm water. A bath is a very important adjunct to a sick-room, for we have no more efficient means of provoking sweat and of soothing nervous excitability than the warm bath. In some cases (suppression of urine, convulsions) it is indispensable. A thermometer should be at hand to regulate the temperature. For a tepid bath we may prescribe 85° ; for a warm 95° ; for a hot 105°.

If it can be done without fatigue, the teeth and mouth should be cleansed occasionally, and the hair brushed.

1063. *Thirst* may be allayed by toast-water, thin gruel, or barley-water, and by soda-water, lemonade, or iced water slightly acidulated, if need be, with sulphuric or phosphoric acids, and sweetened. In the typhous condition spirit or wine may be added to these drinks.

When the tongue is parched, hard, and cracked, a little olive oil should be frequently smeared over it. When sordes tend to accumulate, the mouth should be occasionally cleansed with the finger covered with soft rag moistened with warm water or oil.

1064. *General Management of the Sick-Room.*—All should be quiet and yet cheerful here. If the patient be unduly apprehensive, anxious looks and tones must be avoided in his presence. When he is awake to impressions, there should be no whisperings in his presence or hearing. In the sick-room all our communications should be *with* the patient, either directly or openly through the nurse. We must inspire confidence and hope by a plain, easy, and decided manner. There must be no mystery or ambiguity about our acts and words. We must answer the solicitous inquiries of the patient as simply and straightforwardly as possible, so as to leave no doubt in his mind. "You are better by this little indication." "You are worse because of this complication against which I am going to direct remedies such as we may reasonably hope will cause it to yield sooner or later." "What you want is sleep, and this we will secure for you to-night." Such must be the language of the medical attendant.

1065. The sensations and ideas are so perverted in delirium that patients laboring under mental disease, whether primary or secondary, are best treated by assuming a cheerful indifference. When homicidal and suicidal tendencies exist, cutting instruments must be removed, and windows secured. If the patient obstinately refuse food, do not press it—put it from time to time before him, and let others eat in his presence. Loud, strange, or uncertain noises should be prevented. The influence of music may be brought to bear in certain cases.

1066. In protracted illness, when the intellect is clear, we should vary the position of the bed, and change from time to time the pictures, ornaments, and furniture of the room, and distribute about it Wardian cases, aquaria, growing plants, and cut flowers of various hue ; for anxiety and gloom are inseparable companions of severe illness, and we should not neglect any means, however trifling, of dispelling them.

1067. When a case of contagious fever occurs in a house, and the patient cannot be removed, strict precautions are necessary to prevent the spread of the disease. The younger members of the family should be sent away at once, or, if this be impracticable, they should live and sleep on the ground floor. The patient should be placed in the airiest and most secluded room in the highest part of the house, and only those in attendance should have access to that story. If possible, he should be under the care of a single nurse, and an adjoining room should be devoted to her use, with ready means of communication with the people below. Her food and that of the patient should be brought to the landing on the

floor below, where she should receive it. She should go downstairs as seldom, and keep aloof from other persons as much, as possible. Before leaving her room she should be careful to wash her hands, using a little carbolic acid or carbolic acid soap. A fire and a large kettle of boiling water should be constantly at hand. A separate set of articles should be devoted to the patient's and the nurse's use, and before they are sent away they should have boiling water poured from the kettle upon them. Linen should be treated in the same way, and then wrung out and put aside. It should be allowed to accumulate to the end of the illness, and after a second exposure to the action of boiling water, be sent to the laundress. The patient's room must be thoroughly ventilated. Disinfectants should always be mixed with the dejections, and they should be conveyed to the water-closet in a tightly covered vessel. The water-closet pan should be well flushed, and if other conveniences be near, the rest of the household should not use this one during, and for some time, after the illness.

1068. After convalescence the sick-room must be thoroughly cleansed. Clothes which cannot be washed must be burned. The bed, mattress, and carpets must be baked in a hot oven; oil paint scoured, the ceiling whitewashed, the walls re-papered, the floor scalded, and afterward scrubbed. The door should be kept shut, and the windows open, and a large fire should be kept up during, and for some days after, the cleansing. Boiling water is a thorough disinfectant. We may use such disinfectants as charcoal, chloride of lime, chloride of zinc (Burnett's fluid), and carbolic acid, in addition, but we must not trust to these alone. Burning sulphur is an efficient, but from its destructiveness an objectionable disinfectant, excepting in a completely bare room.

PRACTICE OF MEDICINE.

GENERAL DISEASES.

CHAPTER I.

STATES OF THE SYSTEM.

PLETHORA, ...	The Plethoric State.
ANÆMIA, ...	The Anæmic State.
CACHEXIA, ...	The Cachectic State.
MIMOSIS INQUIETA, ...	The Nervous State.
FEBRICULA, ...	The Febrile State.

THE subjects treated in this chapter have peculiarities which entitle them to a place by themselves. They are rather disorders than diseases properly so called. They consist in a departure from health, more or less permanent, not necessarily complicated with any local affection, and are often present and cognizable in combination with specific and well-defined maladies. A plethoric, an anæmic, or a cachectic patient, one suffering from extreme debility, or from a group of nervous symptoms, may become the subject of a disease, such as fever or small-pox, which will be materially influenced in its character, progress, and termination by that pre-existent *state of system.* The treatment of a disease will also be materially influenced, and in some cases altogether determined, by the state of system on which it has supervened. Again, in all those diseases in which the symptoms are obscure, or the appropriate remedy not yet discovered, the only course open to the physician is to direct his prescriptions to the states of system. Nor ought it to be forgotten that these states of system may be themselves brought on by several analogous local or general causes, and that to recognize them is to possess a clue to the often obscure, and little-suspected, origin of the existing disorder. For these reasons they are treated in a chapter by themselves, and take precedence of diseases properly so called.

PLETHORA.—THE PLETHORIC STATE.

SYNONYMS.—General Hyperæmia.—Polyæmia.—Fulness of blood.—A full habit of body.

DEFINITION.—A state of system characterized by an excessive quantity of blood, or by an excess of its more solid constituents.

Symptoms.—The complexion florid; the capillaries of the surface injected; the redness of the skin momentarily removed by pressure; the lips red; the eyes bright, and the conjunctiva injected; the tongue clean and red, or slightly furred; the appetite generally good; the bowels usually confined; the skin dry, but perspiring profusely on exertion; the pulse frequent, full, firm, and bounding. In strongly marked cases, the pulse is infrequent and laboring, or irregular in force and frequency, according to the degree in which the heart is oppressed. The extremities are cold; the patient is weak, listless, and easily fatigued on exertion, suffers from palpitation, shortness of breath, and frequent sighing; and complains of giddiness, noises in the ears, bright or dark spots before the eyes, and a dull heavy pain in the head.

Terminations.—In local congestions, inflammations, and hemorrhages; in apoplexy, especially in persons with large chests and short necks; in hypertrophy of the heart; in gout.

Pathology.—An excessive quantity of blood, or superabundance of red particles and fibrine; urine with excess of urea.

Causes.—*Predisposing.* A peculiar habit of body, with large chest and short neck. *Exciting:* a highly nutritious diet; beer and spirituous liqors; sedentary habits; too much sleep; inadequate exercise. In females, suppression of the catamenia.

Diagnosis.—By the fulness of the whole capillary system, and the rapid filling of the vessels of the surface on the removal of pressure.

Treatment.—*Indications.* I. To lessen the quantity of blood. II. To increase the actions of the excreting organs.

The first indication is best fulfilled by a spare diet, abstinence from malt and spirituous liquors, early rising, and regular exercise; and the second by the frequent use of saline aperients.

In extreme cases, and where there is a threatening of local congestion, abstraction of blood by venesection, cupping, or leeches may be necessary. But, as a rule, it is better to avoid the letting of blood, and to trust to the prolonged use of abstinence, exercise, early rising, and saline aperients. If amenorrhœa be present, four or six leeches may be applied to the groin at the menstrual periods. If apoplexy or gout impend, the treatment must be modified accordingly.

Prophylaxis.—The diet should be spare and moderately nutritious, with abstinence from malt or spirituous liquors; perspiration should be promoted by brisk exercise; and the bowels kept free by suitable aperients.

ANÆMIA.—THE ANÆMIC STATE.

Definition.—A state of system characterized by a diminution in the quantity of the blood, or of the red particles and other solids.

Varieties.—1. Anæmia from loss of blood. 2. Chronic anæmia. 3. Cachectic anæmia, or chlorosis.

1. Anæmia from Loss of Blood.

Symptoms.—The most familiar effect of loss of blood (or of profuse discharges rapidly poured out) is *syncope* (see p. 225). The fainting state is followed by reaction, and is apt to recur on slight exertion, or change of posture; but in *fatal cases* the symptoms become gradually and progressively worse; the countenance paler and more sunken; the extremities colder and colder; the breathing hurried and interrupted by deep sighs or yawns, panting, gasping, or stertorous; the pulse imperceptible; restlessness and jactitation are followed by coma, or convulsions; at length the strength is exhausted, and the patient gasps and expires. In states of extreme weakness, death sometimes occurs on suddenly assuming the sitting or standing posture.

The state of *reaction* is characterized by peculiar and strongly marked symptoms; by forcible beating of the carotids, with a sense of throbbing and tension in the head; palpitation of the heart, throbbing at the pit of the stomach, and in the course of the aorta, and a frequent, bounding, and often irregular sharp pulse; a hurried, panting, sighing respiration; restlessness, jactitation, and mental agitation; intolerance of light and sound; the sleep disturbed by fearful dreams; the waking hurried and perplexed. Violent delirium, mania, coma, amaurosis, and deafness are among the concomitants of this state.

Post-mortem Appearances.—An empty state of the cavities of the heart, and general pallor of the viscera, most marked in the lungs.

Diagnosis.—By the extreme pallor of the face, skin, lips, and gums.

Treatment.—*Indications.* I. To stimulate the brain with the blood that still remains. II. To maintain the action of the heart by external and internal stimulants. III. To subdue abnormal nervous action. IV. To promote the formation of new blood.

The first indication is effected by placing the head on a level with the chest; the second, by the free exhibition of ammonia, wine, or brandy, and the application of cloths wrung out of hot water, or of sinapisms to the region of the heart; the third, by a full dose of tincture of opium, which is obviously preferable to the solid preparations of the drug. If violent delirium or acute mania be present, as a consequence of the loss of blood, we may repeat the dose at intervals of three or four hours, according to the effect produced. Convulsions declare the most imminent danger, and if the means were at hand we might resort to the transfusion of blood, or to galvanism and artificial respiration. The formation of new blood will be promoted by administering beef-tea, or egg beat up with milk, wine, or brandy, or, if the power of deglutition fail, introducing these into the rectum. Having re-established the circulation, the subsequent treatment will be that of chronic anæmia. For a time the erect or sitting posture must be strictly interdicted.

2. Chronic Anæmia.

Definition.—A state of system coming on gradually, continuing generally for some weeks or months, and dependent on a decrease in the red particles and solid constituents of the blood.

Symptoms.—Universal pallor, extending to the conjunctiva, gums, and membrane of the mouth; dead whiteness of the tongue; cold extremities; debility; fainting fits; palpitation and dyspnœa on the slightest exertion, with violent pulsation of the carotid arteries; headache, consisting generally in a fixed pain over the eyebrows or on the top of the head; pain under the left breast, or a sense of fulness in the chest; pulse frequent, small, and quick (in extreme cases *jerking*), increased by exertion and emotion. The patient is easily agitated by slight noises or unexpected events, and suffers from depression, and, in some cases, from hysteria; the secretions and excretions are generally scanty, and the bowels often torpid.

Physical Signs.—On applying the stethoscope above the clavicles, especially on the right side, a humming sound (*bruit de diable*—humming-top sound, or venous murmur) is heard. Slight pressure of the stethoscope on the larger arteries produces a *bruit de soufflet*, resembling the soft sound caused by blowing across the mouth of a bottle; or the puffing of a locomotive engine. A soft blowing sound is also often heard at the *base* of the heart. In the space above the clavicle the venous murmur and the arterial bellows sound may be heard at the same time. These are indications of a flaccid condition of the arteries and veins. They are not, however, peculiar to anæmia, nor always present in this condition.

Complications.—Often, but not always, associated in women with amenorrhœa, or with scanty menstruation.

Causes.—*Predisposing.* The female sex, especially about the age of puberty. It is rare in males. *Exciting.* In females obscure, but connected with the function of menstruation. In males occasioned by overwork; as with compositors, bakers, and others, who spend much of their time in dark, hot, and ill-ventilated rooms. For other exciting causes, see Cachexia.

Prognosis.—Favorable; but recovery sometimes slow and tedious.

Diagnosis.—From chlorosis, by the absence of disorder in the functions of the alimentary canal. The soft basal bellows murmur must not be attributed to *organic* heart disease.

Treatment.—*Indication.* To promote the formation of the red particles and solid constituents of the blood. This will be effected by the use of the preparations of iron in full doses, together with a nourishing diet. The best preparation of iron is the dried sulphate, of which five grains may be taken three times a day. (Form. 137.) The pilula aloes et myrrhæ may be given, if required, but mercurials should be given with caution, as salivation is readily induced in anæmic patients.

I have often given the dried sulphute of iron, combined with extract of gentian, in ten-grain doses; and an anæmic female, who takes these pills as others take stimulants, swallowed on one occasion twelve pills, contain-

ing half a drachm of sulphate of iron, in one day. The same preparation, in the same liberal doses, may be given with like advantage in the few cases of anæmia that occur in the male subject. (G.)

A generous diet, with a moderate allowance of wine, is indicated in cases of anæmia attended with marked debility; and exercise in the fresh air, proportioned to the strength of the patient. For mental depression, change of air and scene, and the use of chalybeate waters, may be recommended; or sea-air with sea-bathing. The shower-bath is a useful tonic.

3. Cachectic Anæmia, or Chlorosis (Green Sickness).

Definition.—A state of system combining the characters of anæmia with those of cachexia; an altered state of the blood with unhealthy secretions.

Symptoms.—A greenish-yellow pallor of the skin, puffiness, and often œdema of the integument; heaviness; listlessness; fatigue on the least exertion; palpitation; throbbing of the carotid arteries; a small, quick, and frequent pulse; shortness of breath; pains in the back, loins, and hips; indigestion with flatulency and acidity; foul breath, and offensive evacuations from the bowels. The appetite is often singularly depraved; such things as chalk being greedily eaten, and the accustomed food rejected.

Causes.—Those of anæmia and cachexia combined. Amenorrhœa is a general, though not a constant, accompaniment.

Treatment.—*Indications.* I. To restore the normal character of the blood by the means recommended in chronic anæmia. II. To correct the depraved secretions.

The second indication may be fulfilled by gentle aloetic aperients combined with myrrh and a little blue pill.

For the treatment of uterine complications, see amenorrhœa, dysmenorrhœa, etc.

CACHEXIA.—THE CACHECTIC STATE.

Definition.—A disorder allied to anæmia caused by an alteration in the blood from morbid processes arising within the body, or the absorption of some deleterious agent from without.

Varieties.—Syphilitic Cachexia. Alcoholic Cachexia. Marsh Cachexia. Tubercular Cachexia (Tuberculosis). Carcinomatous Cachexia. Cachexia of hot climates. Leucocythæmia. Suprarenal Cachexia.

Symptoms.—A sallow, dusky, or muddy complexion, often tinged with yellow; a dry and harsh skin; a small, frequent, and compressible pulse; the tongue sometimes clean, moist, and red, sometimes pale, but more commonly furred or cracked; the appetite capricious, often craving and voracious; dyspeptic symptoms; the bowels either costive or loose, with dark, slimy, and offensive stools; the urine generally high colored, of a strong odor, and depositing lithates; the perspiration and breath offensive.

Enlarged tonsils, aphthæ, and cutaneous eruptions, are frequent concomitants of this state, as are also obscure and wandering pains of the body and limbs.

Terminations.—In recovery, or in tubercular or other organic diseases of the viscera.

Causes.—*Predisposing.* An ailing infancy, and hereditary defect of constitution. *Exciting.* Unwholesome diet; insufficient exercise; intemperance; continued exposure to marsh miasma, to a cold, damp atmosphere, or to unhealthy climates; the impure air of crowded cities; the gradual operation of mineral poisons, as mercury, lead, copper, arsenic; and of animal poisons, especially the syphilitic.

Prognosis.—*Favorable,* if there be no organic disease, and the patient can be removed from the influence of the ascertained cause. *Unfavorable,* when complicated with visceral disease.

Treatment.—*Indications.* I. To remove the exciting cause. II. To improve the state of the blood. The exciting cause may be removed, in the several cases specified, by proper diet, exercise, change of air, ventilation of apartments in which unhealthy occupations are carried on, and change from unwholesome employments to healthy ones. In syphilitic cachexy preparations of mercury or iodine will be required. The quality of the blood may be improved by a wholesome mixed diet of animal and vegetable food. The condition of the digestive, cutaneous, urinary, and uterine functions must be carefully inquired into, and the nature of the secretions determined. If the bile be vitiated and defective, alkalies combined with tonics, and mercurial purgatives, should be given. If the urine be loaded with phosphates or oxalates, the mineral acids may be given in combination with quinine; and if lithates be present, alkalies, with tonic and stimulant infusions. The skin must be cleansed and stimulated by daily shower- or sponge-baths, followed by friction with a coarse towel. Change of air and of scene, and chalybeates or saline waters, may be prescribed with advantage.

Of the varieties of cachexia specified above, some are described under the diseases which produce them; others, as leucocythæmia and suprarenal cachexia, require separate notice.

Leucocythæmia, Leukæmia, Lymphæmia, is a form of cachectic anæmia, first described by Dr. Bennett of Edinburgh. It derives its name from an excess of white corpuscles in the blood, and is characterized by great pallor, accompanied in some cases by œdema, or by dropsical effusions. The functions of the stomach and bowels are generally deranged, and jaundice is sometimes present. There is great weakness and emaciation, shortness of breath, and in cases of long standing, hectic fever. The blood is found to contain white corpuscles in great excess. It is generally a disease of adults, and is commonly associated with disease of the spleen, which is often greatly enlarged, and of the liver. The lymphatic glands are also often implicated. The disease is chronic, and the prognosis unfavorable, except in the rare cases in which the viscera are not seriously affected.

This state sometimes follows severe attacks of remittent or intermittent fevers, which have left behind them disease of the liver and spleen. The treatment consists in the use of preparations of iron, and of the remedies indicated for the concomitant visceral disease.

Virchow distinguishes two forms of leukæmia, the *splenic* and the *lymphatic*; the spleen being the starting-point of the disease in the one, and some portion of the lymphatic glands in the other; in the splenic form the white corpuscles are comparatively large and well-developed, with one or more nuclei closely resembling the cells of the spleen. In the lymphatic form the white corpuscles are small, and have a single somewhat granular nucleus, attached to the cell-wall. "In many instances it looks as if perfectly free nuclei were contained in the blood."

Cachexia of Hot Climates.—This is common among Europeans resident in hot climates; either as the consequence of disease of the abdominal viscera brought on by attacks of intermittent or remittent fever; or as the mere result of a prolonged residence in unhealthy localities, or again, as the sequel of febrile attacks, not followed by organic mischief. It may also be induced by the injudicious use of the lancet or of mercury, or by attacks of diarrhœa, cholera, dysentery, scurvy, or hepatitis. The leading symptoms are, a pale and sallow countenance, a cold and shrivelled skin, a pearly whiteness of the eye, a dilated pupil, a dull and languid expression, peevishness, and despondency. The belly is generally swollen, and the extremities often œdematous, the digestion weak, the bowels torpid, the tongue pale, and coated with a white fur, the pulse feeble, and the respiration quickened by exertion. The treatment proper for this state consists in the use of the preparations of iron, with aloetic aperients, if needed in the local treatment of visceral complications, and strict attention to all the means of preserving health. A dry and bracing air, mental rest, and suitable bodily exercise, must be particularly insisted on. Preparations of mercury and all lowering remedies are contraindicated.

I have, in one or two instances, seen this state of system following service in hot climates and attacks of intermittent or remittent fever, but without serious disease of the liver or spleen, speedily and entirely cured by the use of preparations of steel. (G.)

Suprarenal Cachexia.—*Suprarenal Melasma, Morbus Addisonii.* This form of cachexia is characterized, like leucocythæmia, by great pallor of surface, pearly whiteness of the conjunctiva, great languor and debility, loss of appetite, an uneasy feeling at the pit of the stomach, and sometimes vomiting of food, feeble pulse, and some loss of flesh; accompanied by a peculiar and characteristic discoloration of the skin over the whole surface, but particularly on the face and under the eyes, on the neck, on the penis and scrotum, the arm and armpit, the navel and epigastrium. The skin has a smoky look, and presents every shade of color from amber to dark chestnut, or even chocolate; sometimes blended with spots or patches of morbid whiteness. The discoloration may also affect the lips, and inside of the cheeks, exactly resembling the dark blotchy condition of

the dog's mouth. Cases in which the discoloration is extensive and strongly marked, end fatally.

Cause.—Disease of the suprarenal capsules. We are indebted to Dr. Greenhow for an analysis of all the published cases of so-called Addison's disease. The following are the results at which he has arrived: There were 10 cases of bronzed skin in which the suprarenal capsules were healthy; 24 in which they were in part or wholly destroyed by cancerous deposit, but in 8 only of which was there any cutaneous discoloration approaching to bronzing; 34 cases of miscellaneous affections of the capsules, in only 16 of which was there any decided bronzing; 59 cases in which the degeneration of the capsules was associated with tubercular and vertebral disease; 23 in which the capsular disease was associated with phthisis and other serious diseases; 5 in which the state of the other organs was not reported; 13 in which the suprarenal disease was complicated with disease of the mesenteric and intestinal glands, or of the lungs or pleura; and only 28 cases in which the disease of the capsules was absolutely unaccompanied by constitutional disease. In some even of these latter, death may have been due to general fatty degeneration and asthenia, for some of the subjects were overladen with fat. Dr. Greenhow rejects the first sixty-four cases in this enumeration as spurious examples of Addison's disease.

MIMOSIS INQUIETA.—THE NERVOUS STATE.

Symptoms.—Flushings, tremblings, palpitations, dyspnœa, pain in the left side, giddiness, loss of memory, low spirits, anxiety, and timidity. In extreme cases the patient is startled by the slightest noise; is in constant apprehension of death, or of some great evil about to befall him; imagines that he has done something wrong; or is in constant fear that he may commit some great crime. The sleep is often disturbed by frightful dreams. Neuralgic pains, with extreme weakness of the hands and forearms, are of common occurrence, and give rise to an unfounded alarm of paralysis. There is often indigestion, and the bowels are flatulent and costive. In other respects the health does not greatly suffer; the patient looks well, does not lose flesh, and may even be of a full habit of body. In women, faintings and hysterical paroxysms are sometimes superadded, and the disease occasionally terminates in mania.

Causes.—*Predisposing.* A nervous temperament. Excessive discharges, such as hyperlactation, leucorrhœa, menorrhagia, diarrhœa, and repeated loss of blood; the change of life. *Exciting.* In either sex, fright, grief, anxiety, overwork, scanty nourishment, or fatigue. In men, excessive study, anxiety, dissipation, and sexual abuse.

Diagnosis.—From serious nervous diseases, such as delirium tremens and mania, by the absence of delirium, and of obstinate delusions.

Prognosis.—Favorable, but recovery generally slow and tedious.

Treatment.—I. Support the patient's strength by the use of astringent tonics (Form. 130), a generous diet, a moderate amount of wine, fresh air, and exercise. II. Allay the nervous irritation by the use of sedatives, such as opium, hyoscyamus, and digitalis.

FEBRICULA.—THE FEBRILE STATE.

Synonyms.—Febris ephemera. Simple fever. Feverishness.

Definition.—A continued fever, of slight degree and short duration, which often runs its course in twenty-four hours.

Symptoms.—Increased heat of skin, sometimes as much as 5° or 6°, and frequency of pulse, flushed face, slightly furred tongue, thirst, loss of appetite, restlessness, lassitude, headache, and general muscular pains. These symptoms are sometimes preceded by shivering, and generally pass off by perspiration.

Causes.—Fatigue ; exposure to cold ; heated rooms ; intemperance in eating or drinking ; slight local inflammation. The poison of typhus fever acting on a strong constitution, or that of any of the exanthemata acting on a person who has already had the disease.

Diagnosis.—From the severer forms of continued fever by the mildness of the symptoms. Caution, however, is necessary in giving an opinion, as the onset of severe cases of continued fever, or of the febrile exanthemata is often not more strongly marked.

Prognosis.—Favorable, but guarded, for the reason just stated.

Treatment.—I. If the febrile attack have originated in intemperance in eating or drinking, an emetic should be given.

II. The feverish symptoms will generally yield to a saline aperient (Form. 242), and low diet. In more severe cases, ten grains of Dover's powder may be given at bedtime, followed by a saline aperient in the morning. The patient should keep his bed, and be restricted to tea, farinaceous food, and cooling drinks, until the temperature remains normal.

CHAPTER II.

LOCAL DISEASES.

Phlogosis, ...	Inflammation.
Congestio, ...	Congestion.
Hæmorrhagia, ...	Hemorrhage.
Hydrops, ...	Dropsy.
Erysipelas, ...	St. Anthony's Fire.

PHLOGOSIS.—INFLAMMATION.

Varieties.—1. Acute. 2. Chronic.

1. Acute Inflammation.

Symptoms.—1. Local. 2. General or Constitutional.

(1.) *Local Symptoms. When External.* Redness, swelling, heat, and pain. The *redness* arises from the increased quantity of blood contained in the vessels of the part; the *swelling* from the same cause, with the exudation of serum, albumen, or lymph; the *heat* exceeds that of other superficial parts, but never rises higher than that of the blood; the *pain* is caused by tension and pressure on the nerves of the part. It is accordingly most severe when the surrounding textures are most unyielding, as in whitlow; comparatively slight, or only produced by external pressure, in the lax mucous membranes. *When internal.* There is pain and disturbance of function. The pain, in parts which can be submitted to pressure, is increased by that pressure, and this forms an important means of diagnosis; and, in the less severe forms of inflammation, pain not existing before is sometimes brought out by it. The *disturbance of function* in secreting organs consists in alteration, diminution, or total suppression of their appropriate secretions, according to the degree of the inflammation; in other organs, of various degrees of excitement—in the brain, rapid succession of ideas, restlessness, delirium; in the eye and ear, intolerance of light and sound, or false sensations, such as flashes of light, musical notes, etc.; in the lungs, dyspnœa; in the heart, palpitation.

(2.) *General* or *Constitutional Symptoms.*—In healthy persons, the group of symptoms commonly known as *Inflammatory Fever;* namely, rigors, succeeded by pains in the head, back, and limbs; lassitude; nausea, and loss of appetite; increased heat of surface; thirst; furred tongue; fre-

quent, full, hard pulse; a dry skin; scanty and high-colored urine; and constipation or diarrhœa. There is a slight aggravation of the symptoms toward evening, and a slight remission in the morning. The sleep is disturbed, and the patient is somewhat delirious. If blood be drawn it will be found cupped and buffed.

In severe and extensive inflammation, or in unhealthy persons, the symptoms are those of *Constitutional Irritation:* extreme anxiety and restlessness; hurried respiration; rigors; a frequent, quick, sharp pulse; low muttering delirium; and, in fatal cases, death by exhaustion.

In the very weak, hectic fever usually shows itself as soon as pus is formed.

TERMINATIONS.—1. Resolution. 2. Increased secretion. 3. Hemorrhage. 4. Adhesion. 5. Softening. 6. Induration. 7. Suppuration. 8. Gangrene.

CAUSES.—*Predisposing.* Sanguine temperament; full habit of body; and exhausted, cachectic, and febrile states of system. *Exciting.* 1. Mechanical injury. 2. Chemical irritants. 3. Cold and heat. 4. An altered or poisoned blood. 5. Local congestion from imperfect elimination of effete matters.

CAUSES WHICH MODIFY THE CHARACTER OF INFLAMMATION.

1. Texture. 2. Condition of system. (1.) *Texture* The *serous* membranes when acutely inflamed take on the adhesive inflammation, very rarely the suppurative; when less inflamed, they pour out serum. The *mucous* membranes secrete mucus, pus, and, in rare cases, coagulable lymph, and are prone to suppuration and to softening, but not to adhesion of opposed surfaces. Inflammation of the *cellular* tissue causes a secretion of serum, and, when very severe, of coagulable lymph and pus. The common termination of inflammation is by *abscess.* Inflammation of the cellular tissues is called *phlegmonous* inflammation. The *parenchymatous* substance of organs is apt to be softened by acute, and hardened by chronic, inflammation; it is also liable to abscess and gangrene. Of the *fibrous* tissues, tendon and ligament are prone to gangrene, cartilage to ulceration. *Osseous* inflammation terminates in gangrene (caries and necrosis). The *skin* resembles the mucous membranes in being prone to suppuration. It is also the seat of diffused redness, pimples, vesicles, pustules, and spots of ulceration and gangrene. Hence the great variety of skin diseases.

The general and constitutional symptoms of inflammation also vary greatly with the tissue affected. In inflammation of the *serous membranes,* there is little heat of surface, little muscular debility, little tendency to delirium (unless the serous membranes of the brain be affected); the pulse is hard; there is acute pain, great tolerance of loss of blood, excess of fibrin, and a cupped and buffed appearance in the blood itself. In inflammation of the *mucous membranes,* on the other hand, there is little

pain, little tolerance of loss of blood, no increase of fibrin, and the absence of the cupped and buffed appearance.

(2.) The plethoric are liable to boils, carbuncles, and adhesive inflammation of the serous membranes. In the anæmic there is but little tendency to inflammation, and when it occurs, it is subacute, and generally results in serous effusion and acute œdema. The cachectic are liable to those low forms of inflammation which result in the deposit of croupy or diphtheritic exudation upon the mucous membranes; to the formation of tubercle in the lungs and lymphatic glands; or the outpouring of sero-purulent fluid into the serous cavities.

The constitutional symptoms which mark the several terminations of inflammation are of great practical importance. *Acute adhesive inflammation* is accompanied by a full, strong, and hard, or small, wiry pulse, somewhat increased in frequency; little or no heat of skin, little or no headache, vertigo, or delirium; no muscular tremor or debility, slight change in the character of the urine, and great tolerance of blood-letting. *Suppuration* is announced by burning, throbbing pain, by severe and often by repeated rigor, occurring in some cases almost with the regularity of ague, and followed by heat and sweating—the symptoms, in fact, of hectic fever. *Gangrene* is indicated by a sudden cessation of pain, by general collapse, pallor, cold clammy sweat, sunken features, sometimes low delirium, sometimes peculiar self-possession. A dry, brown tongue, sordes, a small, frequent, feeble pulse, and the other symptoms of the typhous state, usually precede the fatal ending of extensive or long-continued inflammations.

Treatment.—The remedies against *acute* inflammation are either general or local. The *general remedies* are blood-letting by venesection or arteriotomy, tartar-emetic, in full doses of a fourth of a grain or more, and, after free purgation, the use of calomel and blue pill, combined with opium, in repeated doses, so as to produce slight constitutional effects. In slighter inflammations the use of strong saline aperients will be sufficient. In internal inflammations, diaphoretics and the warm bath are of great service. The *local remedies* are depletion by leeches, cupping, or scarification, incisions, cold, cataplasms and fomentations, and counter-irritants. Inflammation of exposed mucous surfaces require strong irritants, such as nitrate of silver, which have the effect of promoting the contraction of the dilated vessels. Another effective local remedy is pressure, which has been applied with advantage in orchitis and in anthrax.

2. Chronic Inflammation.

Symptoms.—Those of the acute form, but less intense, and of longer duration. The redness is of a more dusky hue; the heat little, if at all, above the natural standard, and the pain very slight, or only produced by pressure. The functions of internal parts when thus inflamed are generally languid, and their secretions are diminished. In chronic inflamma-

tion of the cellular tissue, serum usually takes the place of the more solid products of acute inflammation.

TREATMENT.—This chiefly consists in the use of local remedies, such as moderate depletion by leeches or cupping; friction and stimulants (nitrate of silver, iodine), which cause the capillaries to contract; and counter-irritants. The cold douche, and the interrupted or continuous current are also great aids in promoting the contraction of the capillaries. In chronic inflammation of the lower extremities support, by means of bandages or elastic stockings, is very beneficial. Iodine and its preparations, given internally, promote the absorption of effused matters.

CONGESTIO.—CONGESTION.

VARIETIES.—1. Active. 2. Passive.

1.—ACTIVE CONGESTION.—Sthenic or active Hyperæmia.

CHARACTERS.—A local fulness of the small vessels, analogous to that general fulness which constitutes plethora; accompanied by a more rapid flow of blood, and the florid redness which is present in inflammation.

TERMINATIONS.—In inflammation; active hemorrhage; passive congestion; dropsy.

TREATMENT.—When congestion threatens to pass into inflammation, the moderate abstraction of blood by leeches or cupping, a position favorable to the return of blood to the heart, the use of cold, counter-irritants, and the administration of saline aperients and tonic stimulants, are indicated.

2. PASSIVE CONGESTION.—Passive or Asthenic Hyperæmia.

CHARACTERS.—Distention of the capillaries and small veins, a languid circulation of blood through the part, and a dusky hue.

TERMINATIONS.—In active congestion, in oppressed and sluggish function. In dropsy. In passive hemorrhages. In chronic ulcers of the legs.

CAUSES.—Mechanical pressure. Obstruction to the flow of blood through the lungs, the heart, or the liver. Postures unfavorable to the free return of blood to the heart. Constitutional debility. Cold. Imperfect action of secreting and excreting organs.

TREATMENT.—Must vary with the cause. In congestion of the mucous membranes, and in congestion or chronic ulceration of the integuments, stimulant and astringent applications. The moderate use of aperient medicines, to relieve the general circulation; of stimulants to excite it; and of tonics to support it. Leeching, dry cupping, and friction are also useful remedies in this state.

HEMORRHAGIA.—HEMORRHAGE.

When hemorrhage occurs from excitement of the circulatory organs it is called *active*; when from a congested state of capillaries, *passive*.

1. Active Hemorrhage.

Character.—A sudden discharge of bright-colored blood. It is an accident which may happen to almost any one, epistaxis (nose-bleeding) being the usual form. Certain individuals, and even families, however, inherit a hemorrhagic diathesis (Hæmophilia, "bleeder disease"). From Immerman's statistics, it appears that this condition is about twice as common in Germany as it is in England, while in France and North America it is about half as frequent as in England. According to Grandidier, the comparative frequency of the source of the bleeding in 308 recorded cases was as follows: From the nose, 152 times; the gums, 38; intestines, 35; the respiratory tract (hæmoptysis), 17; the urinary tract (hæmaturia), 16; the stomach (hæmatemesis), 14; female genitalia, 10; tongue, 6; ear, 5; tips of fingers, 4; scalp, 4; other parts, 7.

In these subjects, trifling operations, such as circumcision, leeching, the extraction of a tooth, occasion profuse and sometimes fatal hemorrhage.

Causes.—*Predisposing*. Youth and vigor. Plethora. *Exciting*. Strong exertion; spirituous liquors in excess; violent passions and emotions. The *immediate* cause may be severe wounds; the rupture of a large artery, or of an aneurismal sac; active congestion of a mucous surface; or the laying bare of an artery by ulceration. In hæmophilia there appears to be a congenital defect in the development of the blood-vessels, the largest arteries being in some cases abnormally narrow, while the intima (inner coat) of both larger and smaller arteries is remarkably thin and transparent. Hypertrophy of the left ventricle of the heart has been frequently observed. On the other hand, in the few cases in which careful examination has been made, the blood appears to be unusually rich in red corpuscles and fibrin, while the white corpuscles are notably few. The condition, therefore, approaches plethora, rather than that of anæmia.

Treatment.—Brisk saline aperients, and a low diet; a posture unfavorable to the flow of blood toward the seat of the hemorrhage; rest of the part affected; cool air and cold drinks; ice and cold applications; styptics; digitalis (Form. 77); ergot, turpentine; sulphuric acid (Form. 146). Tannic or gallic acid; acetate of lead. In all cases of extreme debility brought on by excessive hemorrhage, and marked by great pallor of surface, opium and its preparations in full doses are indicated, either alone or combined with astringents, and a liberal supply of port wine.

2. Passive Hemorrhage.

Character.—A slow discharge of dark-colored blood by extravasation from mucous or other surfaces in a state of passive congestion.

Treatment.—That of passive congestion, supra.

HYDROPS—DROPSY OR ANASARCA.

Definition.—An effusion of serum into the areolar tissue, with or without effusion into serous cavities.

Œdema is the term given to local effusions into the areolar tissue. Those that take place into the several cavities are known as *hydrocephalus, hydrorachis, hydrothorax, hydropericardium, ascites, ovarian dropsy, hydrocele, etc.*

Varieties.—(1) Mechanical dropsy, (2) dropsy from debility, (3) febrile dropsy, (4) cardiac, pulmonary, hepatic, and renal dropsy.

Symptoms.—Dropsy generally first shows itself toward evening by swelling of the feet and ankles, which disappears on lying down. By degrees the swelling becomes permanent, ascends, and successively affects the thighs, the integuments of the trunk, the external genitalia. In extreme cases the dropsical effusion extends to the upper extremities—to the chest, neck, and face; and is almost always attended by effusion into one or more of the serous cavities. The parts affected *pit* on pressure with the finger. The skin is pallid like marble, cold and dry, and when the effusion is great, it becomes tense and shining. At length it gives way at several points, the water oozes out, and the contiguous skin becomes red and excoriated; sometimes it is raised up into small blisters, sometimes it sloughs. Except in renal dropsy, the urine is scanty, high-colored, and deposits lithates. Dyspnœa, palpitation, flatulence, and drowsiness are commonly associated with dropsy.

Causes.—With a view to prognosis and treatment it is of the utmost importance to ascertain the cause of the dropsy. The following are the chief points to attend to: 1. If the dropsy be purely local or limited to one side of the body, it depends on *mechanical obstruction* of a large vein—*e.g.*, œdema of head, neck, and upper extremities may be due to an aneurismal or other tumor compressing the descending cava. Œdema of the leg may arise from the pressure on the iliac vein of a cancerous mass in the pelvis, or enlargement of the gland at the femoral opening. 2. *Dropsy from debility* will be recognized by attention to the previous history of the patient. If there have been neither rheumatism nor scarlet fever, and there are no symptoms of organic disease of any great organ, though there be a soft bruit at the base of the heart, we shall have no difficulty in assigning this to its proper cause—anæmia. 3. *Acute or febrile dropsy* is known by its suddenly following exposure to cold; as when a person, after violent exercise and in a profuse perspiration, falls asleep on the cold damp ground; or when, during recovery from scarlatina, the action of the skin is checked by exposure to cold, wind, or rain. This variety has its origin in severe congestion of the kidneys, indicated by the scanty, albuminous, bloody, or coffee-colored urine. *Chronic forms of renal dropsy* will also be indicated by the absence of severe cardiac and pulmonary symptoms, and by the state of the urine, which is pale like whey, highly albuminous, and usually deposits a slight cloud composed of casts of the uriniferous tubules. (See

Acute and Chronic Nephritis.) 4. *Pulmonary dropsy* generally follows an acute attack of general bronchitis in one who has long suffered from emphysema. The lungs themselves may also be œdematous from local debility of their structure ; or they may be the seat of cancer or tubercle. 5. *Cardiac dropsy* is commonly due to disease of the valves of the heart allowing of regurgitation, obstructing the entrance of venous blood into the lungs, and so inducing congestion of the venous system. Occasionally the cause lies in a fatty heart. Abnormal heart-sounds, and a feeble, intermittent pulse, attend these diseased conditions. 6. *Hepatic dropsy* is readily inferred from the history of the patient, the presence of ascites before swelling of the legs, the condition of the liver, the absence of swelling from the upper parts of the body, and scanty bilious urine loaded with lithates and usually free from albumen. (See Cirrhosis and Cancer of the Liver.)

Prognosis.—Favorable, if not dependent on organic disease of long standing, and great severity.

Treatment.—*Indications.* I. To remove the cause. II. To lessen the quantity of the fluid. III. To relieve distress by its discharge.

(I.) In dropsy associated with febrile action, the remedies for inflammation are indicated ; in dropsy dependent on debility, tonics or stimulants according to the degree of the debility ; in dropsy from venous congestion, moderate depletion to relieve the vessels, and regulated pressure to afford support ; in congestive dropsy dependent on organic disease, medicines directed to relieve the disease ; and if the disease has impoverished the blood, tonics and alteratives.

(II.) The effusion may be lessened by increasing the secretions of the skin, kidneys, and bowels—by sudorifics, diuretics, and purgatives adapted to the state of the patient. As sudorifics we may occasionally use the hot-air bath ; salines, such as nitrate of potash, acetate of ammonia, etc. ; as diuretics, the salts of potash or soda, in combination with digitalis, broom, buchu, turpentine, and copaiba, are often beneficial ; as purgatives, the saline aperients, compound jalap powder (gr. xx. to gr. lx.) and elaterium (gr. $\frac{1}{4}$ to gr. 1). The doses and strength of the several remedies must be regulated by the state of the patient, the sudorifics and diuretics belonging to the class of depressants being preferred in inflammatory and febrile dropsy, and in comparatively vigorous states of the system ; and sudorifics and diuretics belonging to the class of stimulants in states of debility. Saline purgatives will be more appropriate in the latter form, and drastic purgatives in the former. Cardiac, hepatic, and renal dropsy require modifications of treatment, and remedies adapted to the primary disease. (See Diseases of the Heart, Liver, and Kidney.)

(III.) When the collection of fluid interferes mechanically with the functions of surrounding parts, we may have to resort to the operation of acupuncture, in anasarca threatening to discharge itself by vesication, or ulceration ; paracentesis abdominis, in ascites ; in hydrothorax, to paracentesis thoracis ; in hydrocele, to tapping, followed by stimulant injections to effect a radical cure.

ERYSIPELAS—ST ANTHONY'S FIRE.

Definition.—A contagious malady, epidemic at certain seasons, consisting in an inflammation of the skin, or of the skin and cellular tissue, spreading from a single centre over a greater or less extent of surface, and subsiding, or disappearing in one part as it extends to another.

Varieties.—1. Idiopathic erysipelas. 2. Traumatic erysipelas.

1. Idiopathic Erysipelas.

Symptoms.—The disease usually sets in with rigors, quickly followed by pyrexia, confusion of intellect, and sometimes delirium or coma. There is nausea, and in some cases vomiting ; in others, diarrhœa ; the tongue is moist and covered with a uniform white fur ; and the pulse is frequent, quick, full, and compressible. After a variable interval of a few hours, or of one or two days, a red spot, accompanied by more or less swelling, appears on the skin. From this centre an inflammatory blush of a rosy, bright scarlet, or dusky red color spreads more or less rapidly, fading away into the healthy skin. The inflammatory area rapidly extends, and the affected and contiguous portions of the integuments become more or less œdematous. As the redness extends, it disappears from, or gradually subsides in, the parts first occupied. After a longer or shorter time the inflammation usually terminates in desquamation of the cuticle, or in the formation of vesicles of variable size, containing a yellowish serum or lymph. The fever is in proportion to the extent of the disease, and only declines after it has ceased to spread, when, in favorable cases, the patient rapidly regains appetite and strength. In unfavorable cases, the fever assumes the typhous character, passes through the several stages, and displays many of the symptoms described under "Typhus Fever" and the patient sinks comatose or exhausted from the fifth to the tenth day ; rarely so late as the fourteenth or twenty-first.

Terminations.—1. Resolution (*erysipelas mitius*). 2. Vesication and desquamation of the cuticle. 3. Œdema (*erysipelas œdematodes*). 4. Suppuration of the areolar tissue (*erysipelas phlegmonodes*), or gangrene (*erysipelas gangrænosum*). 5. Pyæmia. 6. The disease sometimes suddenly leaves one part of the surface, and attacks a distant part (*erysipelas erraticum*). 7. Inflammation of the brain and its membranes. 8. Inflammation and suppuration of the mucous membrane of portions of the intestinal canal. 9. Inflammatory œdema of the glottis producing suffocation.

Erysipelas of the face (*erysipelas faciei*) is by far the most common form. It usually begins on the nose, and thence gradually extends over the entire face, causing great swelling of the nose and eyelids, and, in severe cases, giving rise to horrible disfiguration. Sometimes it descends and spreads over the neck and trunk, but more commonly attacks the scalp. In its passage over the head, the membranes of the brain are often

more or less affected, and there is acute headache, sometimes delirium, violent or muttering, and occasionally coma. From the head it generally extends down the back, and sometimes affects the membranes of the spinal cord. In severe cases, the affection of the membranes of the brain and cord remain for some time, and show themselves by mental excitement, and by numbness and spasmodic twitchings of the extremities. In erysipelas of the head and face there is generally more or less inflammation of the throat, and in rare instances it proves fatal by inducing serous effusion into the submucous tissue of the glottis and epiglottis.

PATHOLOGY.—A special inflammation of the blood-vessels and lymphatics of the skin, which may terminate in resolution, or in the formation of pus attended by symptoms of pyæmia.

MORBID ANATOMY.—Inflammatory or purulent deposits may be found in the viscera, especially the lungs; and upon the serous and mucous membranes.

CAUSES.—*Predisposing.* A full, plethoric habit; constitutional peculiarity; previous affections of the same nature. The adult age; exhausting diseases, such as dropsy, especially renal dropsy, fever, or the febrile exanthemata. *Exciting.* Contagion; cold; excessive heat, or vicissitudes of temperature; exposure to the sun; abuse of fermented liquors; suppressed evacuations; the presence of irritating matter in the alimentary canal; wounds or local inflammation of the common kind occurring in certain constitutions, in certain seasons, and in places where the disease already exists. It is often epidemic during spring and autumn, frequently prevailing in hospitals, jails, and other crowded situations; and it is a frequent concomitant of puerperal fever.

DIAGNOSIS.—From *erythema* by the duskier blush, pain, and swelling, and by the presence of severe pyrexia. *Erythema nodosum* does not spread, and is never accompanied by pyrexia. *Acute eczema* is distinguished by the presence of a minute vesicular eruption.

PROGNOSIS.—*Favorable.* Moderate pyrexia, a rosy or bright scarlet color; not extending over a large surface; no vesications; the febrile symptoms diminishing with the disappearance of the blush; and this, soon after, assuming a yellowish hue, with an abatement of the swelling. The adult age. *Unfavorable.* Typhous symptoms; the inflamed skin becoming a dark rose-color; sudden recession of the inflammation from the surface, and invasion of an internal part; its extension over a large surface without leaving the part it first occupied; livid vesications; weak, rapid, irregular pulse; great prostration of strength; early appearance of coma; original or acquired debility; complication with dropsy, jaundice, or other affections originating in organic disease. Infancy and old age.

CONTAGION.—The disease may spread by contact, or be inoculated and conveyed by fomites. It may attack the same person several times, and may co-exist with other severe diseases. In some years it is epidemic, and may rage with extreme violence.

MORTALITY.—The deaths in London, in a million persons of all ages,

vary from 110 to 260, and average 160. The *rate* of mortality in persons attacked varies from less than one in three to one in ten.

TREATMENT.—*Indications.* I. To subdue inflammation, and promote salutary changes in the part affected. II. To support the strength. III. To prevent spreading to other parts.

(I.) The pyrexia may be subdued by free action of the bowels, kidneys, and skin. A full dose of compound jalap powder may be given once or oftener, and followed by repeated doses (℥ ss.) of acetate of ammonia, combined with gr. v. to gr. x. of the carbonate. The local treatment will consist in the use of warm fomentations, such as decoction of poppy-heads. If the inflammation be limited, the part may be first rubbed over with solid nitrate of silver. Light bandaging is of great service where it can be applied. In every case the inflamed skin should be carefully protected from the air by fine flour, starch powder, carbonate of zinc, or cotton wool. A mixture of two parts of collodion and one of castor oil forms a complete protection. It is elastic, and by its contraction gives the required support to the swollen parts. It should be thickly painted with a camel's-hair brush.

(II.) As the disease is adynamic, stimulants, such as wine, brandy, and ammonia are often needed, more especially in those accustomed to their use. A full dose of opium is often very serviceable. The presence of delirium does not contraindicate the use of stimulants or opiates when they are required.

Tincture of perchloride of iron (♏x.–♏xl.) alone, or combined with quinine, every three or four hours, is a valuable tonic in erysipelas.

If the disease assume a typhous character, we must depend upon stimulants chiefly. A pint, or more, of wine or brandy may be needed in the twenty-four hours; it may be given in the form of the mistura vini gallici. The diet should consist of egg emulsion, milk, gruel, and beef-tea. The iron may be continued during convalescence, or quinine and acid may be substituted.

(III.) If coma and delirium arise, hot bottles or sinapisms must be applied to the feet. Evaporating lotions or ice may be simultaneously applied to the head. If the patient become noisy and restless, a full dose (gr. i.–ij.) of opium will be required.

In phlegmonous erysipelas, and when there is great tension of the skin, relief may be given by scarifications; and the incision must be free and deep if sloughing have occurred, or matter formed. These must be followed by poultices and disinfectants.

PROPHYLAXIS.—Cleanliness, separation, and, if practicable, isolation. Apartments which have been occupied by the patient should be whitewashed and thoroughly cleansed. Two causes are active in propagating, if not in generating the disease in hospitals;—*the use of sponges in dressing wounds* and *wet scrubbing of the floors of the wards.* To avoid the first, fine tow should supply the place of sponges, a fresh bit being used for each patient. Sponges used in the operating theatre should be thoroughly

washed after each operation, and subsequently immersed in hot water saturated with carbolic acid. To avoid the second cause, dry rubbing should be substituted for washing. Floors should never be wetted when patients are lying above them.

2. Traumatic Erysipelas.

In certain seasons, when idiopathic erysipelas is very prevalent, slight wounds and injuries are apt to be followed by erysipelatous inflammation; and those of a more severe character in persons of unsound constitution, or in the healthy inmates of hospitals or public institutions where the disease already prevails, are almost uniformly subject to this complication. The disease often appears in lines extending from an injured toe or finger along the leg or arm; and the lymphatic glands, especially those of the armpit, become affected with diffuse inflammation and suppuration. The symptoms do not differ from those of idiopathic erysipelas, and the treatment will be the same. But in the prognosis, the original injury and the consequent erysipelas need to be jointly considered; and as pyæmia is more common in this variety of the disease, our attention must be constantly directed to the lungs and pleura.

CHAPTER III.

FEBRES—FEVERS.

Class I.

Non-infectious Fevers.

I.	Febricula,	Simple Fever (see p. 247).
II.	Febris Intermittens,	Ague.
III.	Febris Remittens,	Remittent Fever.
IV.	Febris Icterodes,	Yellow Fever.

Class II.

Infectious Fevers.

I.	Typhus,	Epidemic Continued Fever.
II.	Enteric or Typhoid,	Endemic Continued Fever.
III.	Relapsing Fever,	Famine Fever.
IV.	The Exanthemata,	(See Chapter IV.).

NON-INFECTIOUS FEVERS.

General Observations.

Febricula has been already described.. It is caused by some functional derangement. Ague, remittent and yellow fevers, are endemic, and originate in one common external cause, marsh miasma. Apart from their common origin, they have so many other resemblances that we may safely assume them to be varieties of one and the same disease, the differences being due to the variable intensity of the primary or exciting cause. Thus, if the marsh poison be small in amount, or highly diluted, a febrile attack may come on every second or third day, or after longer intervals. But if the dose be larger, the intervals between the paroxysms are shorter and are no longer intermissions—intervals of freedom from fever—but mere remissions of a more intense febrile condition. If, again, the system receive a still more powerful dose of the paludal poison, the fever is continuous, and the internal organs are severely congested and deranged. Between intermittent and remittent fevers, and between remittent and yellow fevers, there are, in truth, no lines of demarcation: they run into each other.

Given a certain source of marsh miasma, the intensity of the fever generated by it will be, *cæteris paribus*, in proportion to the external tempera-

ture. In the Arctic regions these fevers are unknown, and the mildest variety of them rarely passes beyond the fifty-sixth degree of latitude. In the latitude of London, and five degrees south of it, the disease assumes the intermittent type; south of this line it becomes remittent; still nearer the equator, remittent is not to be distinguished from yellow fever.

These fevers are of great interest to a nation which has soldiers and sailors scattered over the whole of the habitable globe, and serving under circumstances of great exposure, fatigue, and privation. Remittent fever, though by no means unknown in England, assumes in some of our dependencies a character of great malignity, rivalling, and even surpassing the Oriental plague itself in violence, and the mortality it occasions. The records of our army serving abroad show that even if we include stations in which the disease is unknown, or very rare, remittent fever attacks one soldier in every eight, of which number at least one-eighth die. If, however, we exclude the stations in which remittent fever is wholly or nearly unknown, the attacks exceed 1 in 7, and the deaths are between a seventh and eighth of those attacked. The mortality, however, varies very much in different places. In the Tennaserim provinces, it is as low as 1 in 27, at Bombay 1 in 25, at Malta 1 in 24; while it destroys 2 in 11 in Ceylon, 4 in 11 in the Bermudas, and 1 in 2 in Western Africa, on which fatal coast the attacks are nearly equal.

The disease derives its name either from the places in which it prevails, or from some prominent symptom. Thus we have the Walcheren, Levant, and Mediterranean fever; the jungle and hill fever of the East Indies; the lake fever of America; the Bulam, Sierra Leone, African, and Bengal fever; the gall fever of the Netherlands; the bilious remittent of the West Indies; and the yellow fever of Jamaica, Gibraltar, and the Bermudas.

Yellow fever, and the more severe remittents, require for their development a combination of marsh effluvia and a temperature exceeding 75° Fahr. Low-lying spots near the coast are its favorite haunts, and it is believed to disappear at an elevation of about 2,500 feet above the sea level.

FEBRIS INTERMITTENS—AGUE.

SYNONYMS.—Intermittent fever. Fever and ague.

DEFINITION.—A fever caused by marsh miasma, and consisting of paroxysms,[1] occurring at regular intervals with perfect intermissions.

VARIETIES.—1. The *Quotidian;* a paroxysm once in twenty-four hours. 2. The *Tertian;* a paroxysm once in forty-eight hours. 3. The *Quartan;* a paroxysm once in seventy-two hours.[2]

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[1] The period between the end of one paroxysm and the beginning of the next is called the *intermission;* the period occupied by one paroxysm and one intermission is called the *interval.*

[2] Also, 1. The *double quotidian*, having two paroxysms every day. 2. The *double tertian*, having a paroxysm every day, those of the alternate days being of equal dura-

Symptoms.—Ague sometimes attacks suddenly; but in most cases it is ushered in by such symptoms as mark the onset of continued fever; and it is not till after several days, or even one or two weeks, that it assumes its perfect form. It is then recognized by the occurrence, at regular intervals, of a paroxysm consisting of three stages—a cold, a hot, and a sweating stage—following each other with great regularity. *The Cold Stage.*—Languor and listlessness; sighing, yawning, and stretching; pallor; blueness of the ears, lips, and nails; shrinking of the features; and constriction of the skin of the whole body (*goose-skin* or *cutis anserina*); a sense of oppression at the pit of the stomach; violent shivering, chattering of the teeth, and trembling of the limbs; pain in the head, back, and loins; the secretions diminished; the urine scanty, pale, and limpid; the pulse small, frequent, and sometimes irregular; and the respiration short and nervous. These symptoms terminate at length in universal convulsive shaking. *The Hot Stage.*—The heat of the body gradually returns; at first irregularly by transient flushes, succeeded by a steady, dry, burning heat, often as high as 106° Fahr. The skin is now swollen, red, and pungent, the face flushed, and the eyes injected. The sensibility becomes preternaturally acute, and the aching of the head is exchanged for acute pain. The pulse becomes quick, full, and hard; there is great thirst; the urine is scanty and high-colored. *The Sweating Stage.*—At length a moisture breaks out on the face and neck, which soon becomes a universal and equal perspiration. The heat now descends to its usual standard; the pulse resumes its wonted frequency and character; the respiration becomes free and tranquil; the urine deposits a sediment; and the patient is for the time restored to health.

Occasional Symptoms.—In the cold stage, coma or apoplexy; in the hot stage, delirium. Convulsions, syncope, rigid spasms, neuralgia, jaundice, dysentery, and petechiæ on the skin, have also been recorded. In ague districts, and in persons who have previously had ague, many diseases assume the intermittent character. Of these, hemicrania, or intermittent face-ache, or brow-ague, is the most common.

Duration of the Paroxysm, etc.—The quotidian is most common in spring, and generally occurs in the morning: usual duration upward of twelve hours. The tertian is a common type; occurs in spring and autumn, commences at noon, and lasts about eight hours. The quartan is rare; it is more severe, occurs in autumn, generally begins in the after-

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tion and intensity. 3. The *triple tertian*, in which two paroxysms occur on one day, and one on the other. 4. The *duplicated tertian*, which returns twice on each alternate day. 5. The *double quartan*, in which a paroxysm occurs on the day succeeding that of the regular quartan, so that there is a perfect intermission only on the third day. 6. The *duplicated quartan*, in which two paroxysms occur on the day of attack, with two days of intermission. 7. The *triple quartan*, in which a slight paroxysm occurs on each of the usual days of intermission. These forms of ague, as well as those which have longer intervals (such as five, six, seven, eight, nine, or ten days, a month, or a year), and are called *erratics*, require the same treatment as the three primary types.

noon, and lasts about six hours. The quartan has the longest cold stage, the tertian the longest hot stage.

The type is subject to change: tertians and quartans become quotidians, and quotidians remittents; or they pass into continued fever.

The paroxysms of ague are sometimes *obscure* (*dumb ague*), or *incomplete*, or *inverted;* sometimes they are irregular or *erratic;* sometimes *partial*, affecting only a portion of the body.

Period of Incubation.—From a few hours to several days, weeks, or months. Average duration, from ten days to a fortnight.

Pathology.—During the cold stage, the blood leaves the capillaries of the surface, and collects in the deep-seated parts, causing congestion of the head, chest, and abdomen. Such vascular, spongy organs as the spleen and liver, are specially liable to suffer, and if the disease last for any length of time, become large and hard (ague-cake).

Terminations.—In chronic enlargement, with induration, softening, or suppuration of the liver and spleen, followed by ascites and anasarca; in fatal dysentery; in apoplexy; in fever of the remittent or continued type. In leucocythæmia. (See p. 244.)

Causes.—1. *Predisposing.* Weakness; intemperance; cold and moisture; middle age; male sex; a previous attack. 2. *Exciting.*—Marsh miasma, the effluvia from decomposing vegetable matter, and from certain soils, impregnated with moisture, but *apparently* free from vegetable decomposition. The danger is greatly increased by exposure to these effluvia at night.

Diagnosis.—Ague can only be confounded with hectic fever, or with rigors arising from some local cause, such as the passage of a gallstone, the introduction of a catheter, or the formation of pus in some internal organ. In doubtful cases, therefore, we must search for a local cause.

Prognosis.—*Favorable.* Cold and temperate climates. The paroxysms short, and of regular recurrence; the intermissions quite free from fever; the postponement of the paroxysms; short previous duration; the quotidian and tertian types; an eruption on the lips.—*Unfavorable.* The disease of long standing; the paroxysms anticipating the usual time; being strongly marked; long; and attended with anxiety and delirium; a feverish state in the intermission; complication with other diseases; enlargement of the liver and spleen; the quartan type.

Treatment.—*In the Paroxysm.* During the *cold* stage the patient should be put into a warm bed, a hot brick or bottle be applied to the feet, and warm tea, or weak wine and water, be given. In more severe cases bags of hot bran or salt on the pit of the stomach, or a warm, hot-air, or vapor bath, aided by friction of the back and limbs.

During the *hot* stage, cool air, cooling drinks, and tepid sponging.

During the *sweating* stage, the patient should be enveloped in a blanket, and when the fit is over he should have a warm bath, be thoroughly dried, and allowed to sleep. Afterward he should take some nourishing food, and, if much exhausted, a little brandy or wine with warm water.

In the intermission, quinine or arsenic should be given in full doses.

Quinine is the most trusty remedy; it may be given in pill or in mixture, with excess of acid, in doses of five, ten, twenty, or even thirty grains daily.

Arsenic (liquor arsenicalis ♏iv., gradually increased to ♏x. or ♏xx.), may be given either alone, or in combination with quinine, every four hours during the intermission. Its effects must be carefully watched.

Previous to the administration of the specific remedy, the bowels should be freely opened by a brisk aperient (Form. 25).

An occasional cholagogue purge will be needed. Emetics given, just before the fit, are often serviceable in arresting it, or in moderating the sweating stage.

The treatment of recurrences of brow-ague and of those intermittent maladies known as masked agues—*e.g.*, intermittent vomiting, diarrhœa, etc., is that of ague itself.

Prevention.—Avoidance of the early morning and evening air, and of sleeping near the ground. The choice of hilly ground, or of a spot where the malaria is intercepted by a wood or broad surface of water. Quickly growing plants, such as Eucalyptus globulus, sunflowers, arrest accumulations in the soil by the process of growth, and vegetation of every kind should be encouraged with this view. Warm and nourishing food before going into malarious districts. Sailors should not sleep on land in such districts, and ships should be anchored at a distance of two or three miles from unhealthy coasts. Small doses of quinine two or three times a day. Thorough drainage, the use of pure drinking-water, and extreme cleanliness.

Sequelæ of Ague.—These are anæmia, enlargement of the spleen and liver, and chronic dysentery.

FEBRIS REMITTENS—REMITTENT FEVER.

Synonyms.—Bilious remittent, remittent marsh, or paludal fever.

Definition.—A non-infectious fever with distinct exacerbations of variable duration and severity, but with no complete intermission.

Symptoms.—The premonitory symptoms are those of ague, but with less sensation of cold, and perhaps no distinct rigor. The head symptoms are more severe; the countenance is flushed; and there is intense throbbing headache and occasionally violent delirium. Tenderness of the epigastrium and right hypochondrium, extreme nausea, and bilious vomiting, with torpid bowels and scanty urine, are among the early symptoms. The stools are dark, often greenish, and very offensive; and there is considerable thirst and a furry brownish tongue. The pulse is variable in force and volume.

The fever subsides as the skin grows moist; and then a remission or moderation of the symptoms occurs. The patient remains in a mild fever,

accompanied by giddiness and lassitude for about two hours, when the febrile symptoms recur, and slowly increase till they attain their former intensity, or exceed it. Paroxysms and remissions follow each other in regular succession for 7, 14, 21, or 28 days; at the end of either of which periods a profuse perspiration may terminate the attack.

In severe cases the paroxysms are more intense, the remissions shorter and less marked, the skin becomes yellow and pungent, the tongue is covered with a slimy yellow mucus, the stools are fetid: the strength sinks, the pulse becomes thready, sordes form on the teeth, tendinous spasms and stupor supervene, passing into fatal coma. This more severe form is not distinguishable from yellow fever.

Duration.—From five or six days, to four or five weeks. Usual duration about a fortnight.

Causes.—Those of intermittent fever. The disease is most common and severe in hot climates; in England it is rare, but this cannot be said of temperate latitudes generally.

Diagnosis.—From continued fever by the recurrence of intervals of comparative freedom from febrile excitement.

Prognosis.—*Favorable*, in proportion as the remissions are more distinct. *Unfavorable*, when the fever assumes the continued type, and in proportion to the suppression of the hepatic and renal secretions.

Treatment.—The worst forms must be treated in the manner recommended for yellow fever. As soon as the intermissions become well marked, the treatment for intermittent fever must be adopted. Quinine or arsenic may then be given, as in ague, during the remission.

Sequelæ.—Those of intermittent fever.

DENGUE, OR DANDY FEVER.

Under this and other names a febrile affection "*sui generis*" has been described by several Indian physicians.

Definition.—A remittent fever, characterized by severe arthritic pains and a rash or scarlet efflorescence, resembling measles, and appearing first on the palms of the hands, thence rapidly spreading over the rest of the body.

Symptoms.—Those of a common cold—viz., lassitude, heaviness of the eyes, slight vertigo, and a sensation of cold creeping down the back. Some patients wake out of sleep with great pain in the head, loins, and all the joints, small and large; others are suddenly seized with arthritic pains and stiffness while walking in the street.

The hands become stiff and swollen, the eyes watery, the conjunctivæ suffused, and the whole countenance bloated, swollen, and flushed. There is intense aching of the eyeballs, which feel too large for their sockets. The pulse is full, strong, and about 100; the tongue moist and coated, and the margins red or scarlet; the skin dry and hot. There is nausea with loss

of appetite, and the bowels are usually confined. The excruciating pains shift rapidly from one joint to another, and there is great debility and restlessness.

Toward the end of twenty-four hours the headache and flushing of the face begin to decrease, and the pain assumes a dull, aching character. Perspiration now appears, and there is great prostration of strength continuing during the whole remission. About the end of the third day the febrile symptoms return, and sometimes even with increased severity. The skin is hot and turgid, and red blotches like measles or scarlatina, often elevated and rough, appear upon the swollen hands and feet, and produce distressing tingling and itching. During the next twenty-four hours this efflorescence gradually spreads over the rest of the cutaneous surface, but dies away the following day, and is followed by desquamation.

The pains generally, but not always, now begin to subside; but the disease does not usually pass away till the patient has suffered a second or even a third relapse of fever.

Duration and Sequelæ.—Relapses are frequent, and the disease may continue for several weeks, and be attended with much debility, and pain of the joints. Cachexia, jaundice, with subacute hepatitis, hemorrhoids, and neuralgia, are frequent consequences of this disease.

Distribution.—This disease has prevailed epidemically in the West Indian Islands, and the southern parts of India.

Causes.—*Predisposing.* Heat, moisture, stagnation of the air. *Exciting.* Derangement of the digestive organs.

Pathology.—Gastric and biliary derangement seem to be the conditions out of which the disease arises, and in its leading features it bears a strong resemblance to the derangement which results in urticaria. The alvine dejections are of a dark green color, or black, scanty, and offensive.

Prognosis.—Usually favorable. But the debility is sometimes so great during the remission as to result in sudden death.

Treatment.—At the onset, emetics and free purgation by means of calomel and colocynth, followed by saline aperients. During the remission, quinine and the mineral acids.

FEBRIS ICTERODES—YELLOW FEVER.

Synonyms.—Typhus or synochus icterodes; febris remittens gravior cum ictero; bilious remittent of warm climates; Bulam fever; mal de Siam; vòmito negro; vomito prieto; coup de Barre, etc.

Definition.—A remittent fever accompanied by yellowness of the skin, and vomiting of a black or dark-brown fluid. (The disease assumes, in different epidemics, and often in the same epidemic, the several types of continued, remittent, and intermittent fever, and appears in every degree of severity, from simple ephemeral fever to the worst forms, attended with yellow skin and black vomit.)

Symptoms.—The disease usually sets in with lassitude, listlessness, faintness, and giddiness, with frequent chills, acute pains in the back and limbs, pains in the head and eyeballs, a flushed face, an anxious expression, an injected, brilliant, and watery eye, and a hot, dry, and harsh skin. The mouth is clammy ; the tongue generally white and moist, or watery, furred at the centre, and red at the tip and edges ; and the patient is usually very thirsty. The pulse is frequent, full, and hard ; the respiration hurried, and interrupted by frequent sighs ; there is great tenderness of the epigastrium, with extreme irritability of the stomach, and vomiting of the ingesta mixed with a glairy fluid. The bowels are confined, and the motions often clay-colored. The urine is sometimes tinged with bile.

After these symptoms have continued, with increasing severity, from a few hours to three days or more, a marked remission takes place, and the symptoms, as well as the sensations of the patient, continue for several hours so much improved as to excite sanguine hopes of recovery. Sometimes recovery dates from this remission, but more frequently the improvement is delusive. The febrile symptoms return, accompanied by increased debility ; a small and frequent pulse ; a cold and clammy skin ; shrinking of the features ; a dry tongue, covered with a brown or black fur ; increased tenderness of the epigastrium, with an acrid burning sensation extending to the gullet, with extreme irritability of the stomach, and vomiting of all ingesta.

After a further interval of twenty-four or forty-eight hours, and sometimes earlier, the more characteristic symptoms appear—viz., jaundice ; incessant hiccup, vomiting of inky black fluid ; a feeble, irregular pulse ; accumulation of sordes upon the tongue and teeth ; petechiæ ; dark and gelatinous stools ; hemorrhage from the mouth, ears, nostrils, or bowels. In fatal cases, death may occur as early as the third or fourth day ; it usually happens about the eleventh day, but occasionally still later.

Such is the usual course of this disease. But the symptoms and mode of termination vary greatly in different countries, in different epidemics, and even in the same epidemic. The following are some of the varieties : —*a.* Sudden coma and death in convulsions. *b.* Sudden seizure with black vomit, and death in a few hours. *c.* Intense pain and tenderness in the epigastrium, incessant vomiting, and death from exhaustion. *d.* Great anxiety and restlessness, with a clean tongue, and nearly natural pulse, followed after a time by black vomit and fatal exhaustion. Death may be sudden, the sequel of a quiet sleep, and it is sometimes preceded by acute pain and strong convulsions.

Sequelæ.—Diseases of the lungs, liver, spleen, or other internal viscera. Chronic dysentery. Slow and tedious convalescence.

Causes.—*Predisposing.* A continued temperature of not less than 75° to 80° Fahr. The latter end of summer and beginning of autumn. The climate of the West Indies, of the south of Spain, of the seaports of intertropical America, of Mexico, and of parts of Africa. It occurs more or less frequently, and with greater or less severity, in the West Indian

Islands, at the Havana, at Vera Cruz, at New Orleans, Mobile, Charleston, Baltimore, Philadelphia, and New York, at Gibraltar and Barcelona. Male sex; intemperance; depressing passions; all the predisposing causes of common continued fever; especially imprudent exposure to night air. Recent arrival at the place where the disease exists. Want of protection by a previous attack. *Exciting.* Marsh miasma, and decomposition of vegetable matter. The disease is most common in swamps at the mouths of rivers, in the low-lying parts of crowded cities, and in ships laden with vegetable produce, or kept in a damp and filthy state.

Period of Incubation.—Less than ten days.

Morbid Anatomy.—General yellowness of the skin, sometimes interspersed with blue or livid spots; the brain and its membranes generally healthy, and rarely presenting effusion of serum or blood; red, livid, or dark-black spots and patches on the mucous membrane of the stomach, and in its cavity an inky black fluid (black vomit). The intestinal canal contains the same black fluid. The intestinal mucous membrane often shows patches of a brown or blackish color, but no ulcers as in typhoid fever. The gullet is sometimes found inflamed and abraded; the liver is either greatly congested, or small and anæmic; the bladder is contracted and sometimes inflamed. In some epidemics blood has been effused into the structure of the muscles.

Diagnosis.—In mild cases not easily distinguished from remittent and enteric fevers; but in severe cases, and in the more advanced stages, it is readily identified by the yellow skin and eye, and the black vomit.

Prognosis.—*Favorable.* A regular and steady pulse; a soft and warm skin; a natural expression of countenance; a moist tongue; a free discharge of urine; a distinct remission; natural sleep of some hours' duration, undisturbed by vomiting; sudamina. *Unfavorable.* Previous intemperance. Recent arrival on the spot where the disease is rife. The early occurrence of any of the characteristic symptoms, such as yellowness of the skin, especially if in patches, or the black vomit; pain in the back; tenderness in the epigastrium; acrid burning sensation in the stomach and œsophagus; incessant vomiting; deep sighing; singultus; great coldness of surface, with a sensation of internal heat; and an irregular or intermittent pulse. Recovery may take place after the most unfavorable symptoms, and, on the other hand, "it is known that in persons sitting up in bed amusing themselves, and apparently in a favorable state, the black vomit has suddenly appeared, quickly followed by death, to the utter astonishment of the medical attendants."—*Gillkrest.*

Mortality.—Very different in different epidemics. The deaths have amounted to 130 or 131 in 134; 19 in 20; 34 in 35; and 1,265 in 1,739; but they have been as few as 6,684 in 16,517; and even as 1 in 8. English regiments in Gibraltar have suffered a mortality of 1 in 11, and 3 in 11 of the numbers attacked; and in Bermuda of 1 in 3, and 4 in 11. The mortality is generally greatest when the epidemic is recent, and diminishes considerably in the course of time.

TREATMENT.—The stomach should be unloaded at the onset by an emetic (Form. 201). The thorough evacuation of the whole of the intestinal canal during the first two hours of the fever cannot be too much insisted on, and purgatives should be freely exhibited until the bowels have acted five or six times.

At first we may give one, two, or three drops of croton oil, or an ounce of castor oil, or from ten to twenty grains of calomel, followed in two hours by a saline aperient. Many practitioners depend mainly upon mercury, given not only to unload the liver and intestines, but also to affect the constitution. After the first aperient dose a quarter of a grain, combined with opium, may be given every two hours, and mercurial ointment may be simultaneously rubbed into the groins and armpits.

Whenever there is a marked remission of symptoms, xx. grs. of quinine should be administered at once, or two grains every hour.

When the *skin* is universally hot and dry, tepid sponging and the affusion of cold water to the head are of the greatest advantage. When there is vigor of constitution, sweating may be induced by packing the patient in a wet sheet. When, on the contrary, the surface is cold, the warm bath, at 100° to 120° Fahr., and warm frictions, should be employed. The *sickness* may be allayed by demulcent fluids, effervescing draughts, ice or ice-water, the *pain in the eyeballs* and *forehead* by cold to the head, the hair having been previously thinned, or the head shaved. Moderate hemorrhage from the stomach or bowels is beneficial, but when excessive, should be checked by sulphuric acid (Form. 146), gallic acid (Form. 155), or lead (Form. 157). *Collapse* must be treated by diffusible stimulants. Extreme *restlessness* in the advanced stages of the disease, and when great debility is present, may be met by opium in doses of one or two grains. The diet should be restricted to milk, gruel, and beef-tea. Wine may be given as soon as the patient appears to require support.

During convalescence, quinine or cusparia will be needed.

PROPHYLAXIS.—Temperance, cleanliness, regular exercise, and a residence, if possible, on a hill or rising ground. The *avoidance* of unhealthy localities, of exposure to the sun, of impure water and stale food. Robust and plethoric persons newly arrived at a place where yellow fever prevails should carefully observe all the rules of health ; keeping the bowels open by the regular use of gentle aperients. The sick should be separated from the healthy ; and hospitals should be spacious, cleanly, and well ventilated. Europeans embarking for tropical climates should arrange to arrive at the healthy season of the year.

INFECTIOUS FEVERS.

GENERAL OBSERVATIONS.

Modern observers have separated infectious fevers other than the exanthemata into three genera—viz., Typhus, Enteric, and Relapsing. These

are collectively called "The Continued Fevers." The generic distinctness of relapsing fever was first established in the epidemic of 1843, and subsequent to this date a similar distinction was recognized between typhus and enteric fevers.

Relapsing fever is a rare epidemic. It appears in times of famine, and is not marked by any cutaneous eruption, by which, and by the abrupt cessation of the fever, and restoration to comparative health for a time, it is distinguished from typhus.

Typhus is essentially a "low" fever, setting in with complete prostration, which increases as the disease advances, until the vital powers become reduced to the very lowest ebb. A characteristic rash and head symptoms sufficiently distinguish this fever.

Gastric and intestinal symptoms, on the other hand, mark the access and progress of *enteric fever*.

Typhus, like relapsing fever, is the companion of squalor and want. It is supposed to occur only in epidemics, but we have reason to believe that it exists *continuously* to some extent and degree. Of these fevers, typhus is the most infectious; enteric the least so. The mortality in typhus and enteric is pretty equal; that of relapsing fever comparatively small.

TYPHUS—EPIDEMIC CONTINUED FEVER.

Synonyms.—From its prevailing character—Contagious, Infectious, Putrid, Pestilent, Malignant, Epidemic, Ataxic, Asthenic, or Adynamic Fever: After a leading symptom—Brain Fever: From the appearance of the skin—Eruptive, Petechial, Maculated, or Spotted Fever: After the places in which it most commonly prevails—Prison, Jail, Camp, Ship, and Hospital Fevers, and Parish Infection.

Definition.—A continued fever of fourteen to twenty-one days' duration, accompanied by extreme prostration, great disturbance of all the bodily and mental functions, and a strong tendency to cerebral complications; and characterized, in most instances, at an early period, by a peculiar rash.

Symptoms.—The invasion is either sudden and well marked, or gradual and obscure.

In the first case, the disease is generally announced by a succession of severe shivering fits, followed by acute pain in the head, aching in the back and limbs, lassitude and weariness, an unsteady gait, and prostration. The surface is cold and pale, the skin contracted, and the pulse either small and weak, or full, quick, and very compressible. The breathing is quickened, and often interrupted by deep sighs. The expression is dull, anxious, and confused, and sometimes closely resembles that of intoxication. The appetite fails; in some cases there is nausea; the bowels are generally confined, and the tongue is coated with a dirty white fur; the pulse is feeble and fast, but rarely exceeds 120.

In the second case, the symptoms are often so obscure that it is not easy to determine whether the patient is suffering from continued fever, slight indigestion, or a common cold. He has no well-marked rigors, no severe pains in the head, back, or limbs: but he is pale, languid, weary, and drowsy, and complains of dull headache; is disinclined to exertion, and incapable of application. His appetite fails; the tongue is covered with a thin white fur, the bowels are constipated, the pulse somewhat increased in frequency; he passes restless nights, and wakes unrefreshed. This period of uncertainty may last three or four days; and the transition to a state of undoubted fever be so gradual that no precise time can be fixed at which the disease may be said to have been first present. The history of the cases, revealing the fact of an exposure to contagion, is often the best aid to a correct diagnosis.

This premonitory stage, whether the onset be sudden or gradual, passes more or less rapidly into fully developed continued fever, marked by pungent heat of skin, frequent pulse, thirst, headache, throbbing of the temples, flushing of the face, suffusion of the eyes, and great restlessness and irritability. The countenance is dusky, and expresses indifference or confusion of mind. Questions are answered slowly, and as if with difficulty, but rationally. The patient grows weaker, and about the *fourth day* is in bed, lying on his back, and unable to rise without assistance. If he gets any sleep it is disturbed by dreams; he mutters and often starts, and wakes unrefreshed; but in some case there is great drowsiness; in others a total absence of sleep. The tongue, which is at first coated with a moist dirty-white fur, or marked with a dry brown streak along, or on each side of, the middle line, becomes uniformly covered with a dry brown coat. The urine is scanty and high-colored, and is apt to accumulate in the bladder.

About the fifth day, but varying from the fourth to the seventh, a diffused rubeoloid rash makes its appearance on the trunk, being usually best developed on the chest and front of the shoulders, occasionally on the backs of the hands, but rarely on the face. In some cases, and in some epidemics, the rash is very faint, and the dusky skin is slightly freckled with light brownish spots. In other cases, and in other epidemics, the skin is thickly speckled and blotched with dusky purple petechiæ. Between these two extremes there is every degree of intensity. When moderately developed the rash bears a strong resemblance to that of measles, but it is finer and has a duskier tint. The spots are scarcely elevated above the surface; their form is irregular; they have no defined limit, but fade away into the duskiness of the surrounding skin. At first they have a florid venous tint, and disappear on pressure; but when they are a day or two old they cease to be prominent, become paler and of a dirty-brown color, and no longer disappear on pressure. When the number is limited the spots are isolated and scattered; but when the rash is copious they are loosely gathered into irregular patches. About the *seventh day* delirium begins to attend the waking hours, and the patient mutters constantly and incoherently, or talks

loudly and wildly; and at this period there may be some difficulty in restraining him, though usually he is not strong enough to get out of bed. The head is intensely hot, and the face and neck suffused with a vivid coppery blush. Still the patient may be roused, and will open his mouth and fruitlessly attempt to protrude the parched brown tongue, which, as well as the teeth, are blackened with sordes. The breath and cutaneous exhalation have a peculiar rank cadaverous odor; the former contains free ammonia. The pulse ranges from 90 to 120, varies in volume; and is soft and compressible. Stupor now begins to alternate with delirium, and the patient lapses into a state of apathy. He is deaf; his expression is vacant; the eyes filmy; the mouth open; deglutition begins to fail; the hands are tremulous and convulsed, constantly grasping at objects in the air, or picking the bedclothes. This critical condition may continue for twenty-four hours or more, and then the patient may begin to rally. The crisis occurs about the *fourteenth day;* and if favorable, the patient falls into a sound sleep, the skin regains its warmth, the pulse falls and increases in force, the skin and tongue begin to moisten, the patient regains consciousness, a gentle perspiration sets in, the alvine and urinary secretions become more abundant, the tongue rapidly cleans, and with this improvement in the symptoms there is a craving for food. The pulse may fall to 60 or even 40. If, on the other hand, there be no amendment, the patient sinks into complete coma, the skin soon becomes cold and clammy, and the toes and fingers cold and blue, the pulse more frequent, thready, and occasionally imperceptible, the power of deglutition is lost, congestion of the lungs supervenes; the patient lingers awhile, and then dies suffocated.

Concomitant Affections.—Nervous System.—The brain is very soon affected in typhus, persistent dull *headache* being usual during the first week. It is attended by vertigo, and expressed by moans or cries. Toward the end of the week delirium takes its place. This is sometimes slight, being an incoherent muttering (typhomania); in other cases it is so violent as to be mistaken for acute mania; and the patient, if not narrowly watched and restrained, will sometimes effect his escape from his attendants, and throw himself out of window, or place himself in circumstances of great danger. Between these two extremes there is every degree of intensity, proportioned to the vital power of the patient, acute delirium being more common in the young and robust than in the aged and feeble. *Wakefulness* is present in most cases, and may continue for fifty hours or longer. *Somnolency, stupor, apathy,* and *coma* come on in succession as the disease increases in severity; at the same time the *special senses* become much blunted, as is well seen in the deafness which invariably accompanies the disease. *General convulsions* are rare, appearing occasionally toward the close of the disease; and often indicating suppression of urine. A fatal termination may be expected when such grave symptoms arise.

Muscular System.—*Prostration* and a painful sense of weariness are among the earliest symptoms; and *general muscular pains* simulating acute rheumatism and of considerable intensity, are sometimes present in the

early stage, and may mislead us in our diagnosis. Later in the disease *paralysis* affects the sphincters of the bladder and rectum, the excretions are passed in bed, and the urine dribbles from an over-distended bladder. The muscles of mastication, deglutition, and vocalization are similarly affected; the tremulous tongue cannot be protruded, fluids are swallowed slowly and with difficulty, the voice becomes feeble and the speech inarticulate. *Muscular tremor* is always present, and sometimes *tonic spasms* affect some group of muscles.

Respiratory System.—Pulmonary complications are very common. *Bronchitis* occurs to some extent in almost every case; *pneumonic* and *hypostatic congestions* in many; the former occurring in the earlier stages, the latter toward the crisis. They are indicated by difficult breathing, and lividity of the lips and face. Pain is rarely complained of, and the cough and expectoration are not in proportion to the pulmonary disease. Quick breathing, a little wheezing with slight cough, and occasional expectoration of colorless, frothy, or russet and viscid sputum, are sufficient indications of pulmonary mischief, and, on examining the chest, we detect extensive rhonchus and mucous crepitation. Congestion is indicated by dulness on percussion, and bronchophony. *Pleurisy* occasionally supervenes, and mostly with fluid effusion.

Glandular System.—1. The *Liver*.—Jaundice is very rare. 2. *Inflammation of the parotid, axillary, and cervical glands,* with rapid suppuration is a severe complication. These affections often appear about the time of convalescence, and either prevent or greatly retard it, for the adjacent integument becomes indurated, and the sloughy cellular tissue surrounding the glands separates very slowly. *Buboes* in the armpits and groins, and carbuncles are rare. *Phlegmasia dolens* is also a rare sequel. 3. The *Kidneys*.—The quantity of urine is diminished, color reddish-brown, specific gravity high; the urea and uric acid are considerably increased. The chlorides gradually diminish, and are at last reduced to a mere trace. Dr. Buchanan gave a patient 1½ ounce of chloride of sodium, but not a trace could be detected in the urine afterward. A trace of albumen is found in about half the cases; it commonly appears after the seventh day. Occasionally *suppression of urine* occurs, which may or may not be attended with convulsions.

The Skin and Integument.—1. *Boils* sometimes appear during convalescence. 2. *Erysipelas* is apt to occur when prevalent. 3. *Gangrene* and *sloughing* of the integuments, preceded by redness of the skin, are common in the advanced stage of the disease, in parts subject to pressure, and large bed-sores are often formed over the sacrum and trochanters.

Stages.—1. *Period of incubation* about ten days. 2. *The stage of invasion,* extending from the commencement of the illness to the appearance of the rash, from four to seven days. 3. *The stage of nervous irritation,* restlessness, wakefulness, and delirium, extends from the end of the last stage till somnolency comes on; a period of three or four days. 4. *The typhous stage.* This is the last stage of many other diseases, as well

as of typhus, and is commonly called the "typhoid" stage. We abandon this term because it is often used to designate enteric fever. In the typhous stage the patient lies on the back; has a rapid thready pulse; muttering delirium, stupor, or imperfect coma; a dull fixed eye; and an open mouth, exhaling an offensive odor, and displaying a hard, dry, and brown tongue, with sordid lips and teeth. The evacuations are passed involuntarily, and the hands are convulsed. 5. *The convalescent stage.* A month is usually sufficient to restore the patient to health; shedding of the hair is common, but there is no permanent derangement of the functions.

DURATION.—Convalescence mostly commences on the fourteenth day, but in mild cases about the end of the first week. It is occasionally postponed to the twenty-first day.

PROGNOSIS.—*Favorable*, if the patient be young, well nourished, and of a non-excitable temperament, if the pulse maintain moderate bulk, and do not exceed 120, and there be no tendency to pulmonary complication. *Unfavorable*, if the patient be beyond sixty, and feeble, if the pulse be weak and intermittent, or if it much exceed 120, if the rash rapidly become petechial, if pulmonary complications appear early.

MORTALITY.—Out of 4,787 admissions into the London Fever Hospital, 1,000 = 20.89 per cent., or 1 in 4.78 died. Deducting those cases which were fatal twenty-four hours after admission, the mortality falls to 19.56 per cent. It is greater in males than in females.

PATHOLOGY.—The *blood* is very dark and fluid; and if we meet with coagula, they are soft and friable. If pneumonia have existed, firm yellowish clots are found in the right side of the heart. Taken during life the blood is found to be deficient in fibrin; urea may often be detected in the serum, and ammonia is present in appreciable quantity. The *bile* is dark and thick, like treacle. I have observed its specific gravity as high as 1,050. With water, it forms a golden yellow feebly alkaline solution, which possesses the reactions of healthy bile. On evaporation it yields a large, glistening, and brittle black residue, smelling strongly of fatty matter. The *muscles*, including the *heart*, are dark and easily torn. The *brain* and *nerve tissue* are firm and healthy, but the cerebral membranes are commonly gorged with blood. Passive effusion of serum tainted with urea between the membranes and into the ventricles is one of the usual results of typhus; inflammatory exudations, such as jelly-like serum beneath the arachnoid, a few small patches of coagulated fibrin on the upper surface of the pia mater, and shreds of coagulated lymph in the lateral ventricles, are rare. The *kidneys* are often found greatly congested. The *alimentary canal* is everywhere healthy, or only congested in its most vascular portions. The *liver* and *spleen* are more or less congested and softened. *Effusions* into the serous cavities are common. The *respiratory organs* show varions lesions. The mucous membrane of the respiratory tract is injected and soft; the lungs may be œdematous, engorged, or partly consolidated. The air-tubes are commonly filled with frothy fluid.

Geographical Distribution.—Typhus prevails in every country of Europe, and is therefore so far independent of climate. Italy, Spain, and Great Britain appear to have suffered most from its ravages; and in Ireland it would appear to be endemic. It is prevalent in Canada and the United States. We have no evidence of its existing in Australia and New Zealand; nor in South America, in Asia, or Africa, where fevers of all kinds have been confounded together. Many suppose the plague to be the typhus of tropical countries.

Causes.—1. *Predisposing: Depression of vital power* from mental or bodily exhaustion; hence the disease is most common in adults. *Season and temperature:* Typhus appears to prevail, *cæteris paribus,* irrespective of these conditions. *Overcrowding with imperfect ventilation* and *insufficient food* are very powerful predisposing causes. Even in London, typhus is rare among the middle and upper classes. The severest epidemics have appeared in times of scarcity.

2. *Exciting: The infection of a specific poison* generated within the bodies of persons suffering from prolonged privation and exposed to animal exhalations. No other fever is so infectious as typhus. It spreads quickly through a family: nurses and medical attendants, if they do not use sufficient precaution, invariably take it. The poison is contained in the cutaneous and pulmonary exhalations of the patient, and is no doubt introduced into the system through the lungs.

Diagnosis.—Extreme muscular prostration, with general dull aching pains, a weak pulse, dusky complexion, dulness of the senses and intellect, heavy persistent headache, a peculiar dusky rash and a bad odor of the body, are the marks of typhus. But excepting the rash, which does not appear until the fourth or fifth day, these symptoms are not conclusive; and the true nature of the disease may be very doubtful during its early stages, when it may be mistaken for enteric or relapsing fever, measles, phrenitis, suppression of urine, and for such diseases as pneumonia and pyæmia, when they assume the typhous character.

Enteric and relapsing fevers are distinguished at pp. 281 and 286. Coryza, catarrh, and a patchy, bright-colored rash distinguish measles. *Phrenitis* is ushered in by great irritability of temper; the senses are painfully acute, so that light and sound are intolerable, and the eyes are bright and wild. Strabismus and sympathetic vomiting are common symptoms; there is no rash. If *meningitis* be present, acute mania, with intolerable pain in the head, is superadded.

Low forms of inflammation of the brain are not difficult to distinguish. The history of the case, and the absence of much fever and rash, will guide us. *Uræmia* is characterized by the sudden accession of stupor, rapidly passing into coma; and convulsions, which are rare in typhus, are generally present in this disease. *Pneumonia.*—General pneumonic engorgement of asthenic form is still more difficult to distinguish from typhus; indeed, the typhus poison, in common with other animal poisons, often produces rapid engorgement of the lungs and depression of the

vital power, and death occurs in such cases before the specific symptoms of the fever have had time to declare themselves.

Prophylaxis and Disinfection.—Avoid the exhalations from the patient; dilute and carry them away by direct and free ventilation; distribute about the room lumps of wood charcoal, and hang about the doorways cloths wetted with carbolic acid water; subject all infected articles of clothing to the action of boiling water, or to steam, and subsequently rinse them in water holding carbolic acid in solution. Mattresses should be well baked in an oven, and feather-beds should be disinfected.

Treatment.—The patient should be placed in a cool, well-ventilated room, in which a brisk fire is constantly burning, with a nurse in constant attendance. If the skin be pungently hot, the patient should be immersed for five minutes in a warm bath; if there is less heat of skin, tepid sponging will suffice.

The heat of the head may be allayed by iced water, poured in a small continuous stream from a height for the space of ten or fifteen minutes. The head should be shaved whenever the brain symptoms are severe, and if the headache be not relieved by the cold douche, blisters should be freely applied to the forehead, or to the whole of the scalp. The bowels should be kept in free action by cholagogue purgatives. Sleeplessness, nervous excitement, and delirium must be combated by hypnotics. Of these opium is the best, given in moderate doses at first (♏xv. of tincture, gr. v. of compound soap pill, or gr. x. of Dover's powder); if necessary the dose must be increased.

But the chief indication is to support the failing strength. Constant good nursing is indispensable. In the early stages food is generally taken well. It should consist of eggs, milk, beef-tea; three or four eggs may be given daily, with tea or coffee, in the form of emulsion. Alcoholic stimulants are invaluable in typhus, and may be administered throughout the disease. The quantity must be determined by the state of the pulse. If it be of fair volume and under 120, little or no alcohol will be needed. If it be failing and the patient cannot take much food, we may give from ℥vj. to ℥xvj. of brandy, or an equivalent quantity of wine, in the twenty-four hours. Brandy is the best stimulant; it should be mixed with water, eggs, or milk, and given every one or two hours. Delirium does not contraindicate it.

Of medicinal stimulants ammonia is the best. (See Forms. 1 to 15.)

After the crisis quinine and acid is a very useful combination.

Strict attention must be paid to the state of the bladder, especially in the later stages of the disease, when the patient becomes apathetic and the muscular tissues weak. When there is retention the urine must be drawn off twice a day.

We should carefully examine, from day to day, the integuments over the sacrum and trochanters; and ascertain the temperature of the feet. Bed-sores and mortification of the toes are grave complications, which may be generally prevented by proper vigilance.

The breathing must be carefully noticed. If the inspirations exceed twenty-five per minute, we must examine the chest. If pleuritis or pneumonia be present, hot poultices or blisters will be necessary. If there be cough and wheezing, with hurried breathing and mucous crepitation, mustard poultices or turpentine stupes should be applied to the chest, and expectorant stimulants (Form. 216) administered.

If inflammatory swelling of the parotid arise, we must endeavor to prevent suppuration. For this purpose a few leeches may be applied, and as this is a complication that supervenes about the time of convalescence, we may generally exhibit iron and quinine freely. The quantity of alcoholic stimulant should also be increased, and the diet should be as nutritious as possible. As soon as fluctuation is detected free incision should be made

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CEREBRO-SPINAL FEVER.

Under the terms, Epidemic Cerebro-spinal Meningitis, Purpuric Fever, etc., a variety of typhus in which spinal symptoms are prominent has been described. The early symptoms are those of typhus, with more severe myalgia than usual. Pain in the muscles of the neck is especially complained of ; and the body generally, but more especially the spine and abdomen, is affected with acute neuralgia. The delirium and stupor are always great ; the head is stiffly retracted and the muscles are in a state of tetanoid rigidity or spasm. As the patient lies a little over to one side, the body is often stiffly arched backward ; sometimes an arm is constantly retracted ; sometimes the legs are rigidly flexed upon the thighs ; occasionally the muscles of the face and eyeballs are implicated, as indicated by trismus, fixed risus, or strabismus. In most cases, a cutaneous petechial rash appears very early, and the petechiæ often form large blackish blotches, which may become raised, vesicular, and sometimes gangrenous. In some outbreaks herpetic eruptions are common.

At first there is hyperæsthesia, but the patient soon lapses into coma, and usually dies between the first and the eighth day. Sometimes the usual premonitory symptoms are absent, and the patient falls into a state of collapse, rapidly passing into coma, purpuric blotches appearing simultaneously.

After death, great vascularity of the pia mater of the brain and spinal cord, with more or less clear or milky serum effused into its meshes, will be found.

Examples of this variety of fever occur every now and then during epidemics of typhus, as has been particularly noticed in the United States, on the banks of the lower Vistula, and in Ireland. The treatment is that of ordinary typhus, with especial regard to the cerebro-spinal symptoms. The shaved scalp should be blistered, and a long narrow strip of blistering plaster placed over the upper half of the spine.

ENTERIC FEVER.

Synonyms.—Typhoid, pythogenic, gastric, intestinal, bilious continued, and cesspool fever ; muco-enteritis ; abdominal typhus.

Definition.—An endemic contagious (?) fever, generated by the contents of sewers or cesspools, and by water, milk, or other liquids polluted by excreta.

Symptoms.—The onset is generally insidious. There are no marked premonitory symptoms ; chilliness, loss of appetite, and slight pyrexia—sometimes accompanied by nausea and a little diarrhœa, and sometimes not—mark the outset of the disease in most cases. In others, vomiting and diarrhœa, with some abdominal tenderness, are the earliest indications. On careful examination some evidence of gastro-intestinal irritation will always be found, and the abdomen is tender on pressure. The tongue is furred, and red at the tip and edges ; the pulse is small, frequent, and sharp ; the face is pale and somewhat pinched ; but the cheeks have a circumscribed blush. The patient becomes weak, the skin is hot and dry, the lips cracked. There is complete anorexia and much thirst. This is usually the state of the patient when he first comes under the notice of the medical practitioner, and states that he has been feeling unwell for about a week. On the *seventh day*, or a little later, a few round, well-defined rose-colored spots may appear on the abdomen, chest, or back. These spots somewhat resemble the papulæ of variola in their earliest stage, but they are not so large or so hard. They are elevated, and disappear on pressure. In at least half of the cases, and in the worst form of the disease, they are altogether absent. When present, they are easily overlooked, for in most cases they do not exceed half a dozen over the whole of the chest and abdomen, and very often not more than three. Their number bears no proportion to the severity of the disease. Forty-eight hours after their appearance the spots begin to fade and new ones arise, which in like manner disappear, and are succeeded by another crop. The abdomen is now usually found more or less tympanitic and tender, the tenderest part being the right iliac fossa, where pressure commonly produces gurgling. Now, if not earlier, diarrhœa usually sets in with greater or less severity, with watery stools of a light yellow color. The tongue is covered with dirty white fur, and is cracked and aphthous ; but if the purging continue, it becomes dry, brown, and contracted, or red and glazed ; it is usually more or less fissured, and occasionally presents large patches of superficial ulceration. The teeth are crusted with sordes. The pulse ranges between 90 and 120 ; the skin is dry and hot, the thermometer usually showing a daily fluctuation from 102° to 103° Fahr. in the early morning, to 103° to 105° in the evening ; the cheeks wear a hectic blush, and there may be much delirium. During the second week of the disease, and afterward, hemorrhage from the bowels may occur, and if severe, is indicated by sudden blanching. The patient dies without the discharge of blood per anum, and in this case the intestines will be found

distended with blood. In other cases the hemorrhage recurs and the patient becomes pallid and much prostrated. Hemorrhage, however, is not the only danger. The patient is often cut off by perforation of the intestine. This dreaded result may be expected if the purging be frequent and persistent, if the tenderness and tympanites increase, and if vomiting and hiccough supervene. Perforation is usually preceded by symptoms of general peritonitis, excessive tympanites and persistent hiccough and vomiting. A paroxysm of more intense abdominal pain may indicate that perforation has taken place.

The patient may be conscious and acutely sensible of his condition throughout the disease to within an hour or two of his death; but when the diarrhœa is very exhausting and protracted he usually falls into a state of apathy, with a little delirium at night. He lies motionless in bed, and is now liable to bed-sores. Emaciation occurs very rapidly, and if no amendment take place the typhous condition becomes established; the tongue and teeth are blackened with sordes; stupor with convulsive twitchings, delirium, and coma, succeed each other; the motions are passed involuntarily, and the patient gradually sinks.

In favorable cases the improvement is often very slow. The number of stools gradually diminishes, and they become more solid; no fresh spots appear; the temperature of the skin falls, and perspiration appears; the tongue cleans and the appetite returns.

Such are the usual symptoms; but they are subject to considerable variation. Profuse diarrhœa, with vomiting, may be amongst the earliest symptoms; or, on the contrary, obstinate constipation. There may be noisy delirium from the commencement of the disease. In the very mildest cases the worst complications may at any time supervene, and exacerbations from very trifling and often non-apparent causes may be expected.

Convalescence is in some cases interrupted by a relapse, generally traceable to some error of diet; a crop of fresh spots appear, and diarrhœa again sets in, to be followed perhaps by more urgent symptoms.

The average duration of the disease is above four weeks; it is rarely terminated in three. After a severe attack, convalescence is much protracted, and the patient may not be safe for many weeks.

Complications and Sequelæ.—*Bronchitis*, *pleurisy*, and *pneumonia* are frequent complications. *Laryngitis*, with croupous exudations, and ulceration, is not uncommon. Impending suffocation is sometimes relieved by the ejection of fragments of tough membrane. In such a case aphonia may result, and continue for several weeks. *Abortion* and *phlegmasia dolens* are liable to occur during an attack of enteric fever. *Peritonitis*, *perforation*, and *hemorrhage* occur as natural results of the progress of the disease. If the ulcers of the intestine erode a small artery, more or less hemorrhage occurs. If the progress of the ulceration be not checked, it may soon reach the peritoneal covering, and excite peritonitis, which may be local from adhesion of the coils of the intestine, or, in the absence of such adhesions, general. *Perforation* usually occurs about six inches from the

ileo-cæcal valve. It is rarer than is generally supposed. The deepest part of the ulcer often, indeed, lies on the attenuated peritoneum, which here and there presents a slough, pretty firmly adherent, and retained in its position by solid effusion on the intensely inflamed serous surface. When perforation occurs, the peritoneal coat becomes excessively thin, and gives way in one or more places. The apertures are generally small and rounded. *Inflammation and suppuration of the parotid* sometimes occurs, but more rarely than in typhus. *Marasmus* is almost a necessary result of a severe form of the disease, since the mesenteric glands, as well as the solitary and agminated glands of the intestine, are so directly and extensively involved. Retention of urine sometimes comes on very early. It may be the only distressing symptom. (G.)

PATHOLOGY.—Whatever the ultimate cause of enteric fever, it manifests itself in derangement of function, and lesion of structure, of the alimentary canal. The lips are cracked; the tongue fissured, and often covered with ragged aphthous ulcers; and the pharynx and œsophagus occasionally present the same lesions if the disease be protracted beyond the third week. The stomach and duodenum, however, are unaffected, and the disease chiefly, in many cases exclusively, attacks the lower part of the small, and the large intestines. But it is upon the solitary and agminated glands (Peyer's patches) of the *lower third of the ileum* that the disease expends its virulence; and there we invariably find disease after death. In the early stage (on the fifth or sixth day) these normally obscure glands are red, swollen, and distinctly elevated above the surrounding mucous membrane; the blood-vessels of the surrounding mucous membrane are seen converging toward their centres; and the corresponding part of the peritoneum presents a patch of dilated vessels. At length the swollen gland becomes soft and abraded; and this first stage of degeneration is quickly succeeded by sloughing or ulceration. Sometimes a whole Peyer's patch is covered with a discolored, ashy-looking slough. When the slough has separated, or the ulcer advanced, the surface exhibits a ragged appearance, being formed of angry-looking granulations, of various sizes, enclosed in an irregular network of sloughy areolar tissue. The edges of the ulcer are hard and elevated: externally they are rounded and smooth, internally they are ragged with excavations. In proportion as the base of the ulcer nears the peritoneum, this membrane becomes inflamed, and when the ulcers are numerous the inflamed patches become confluent, the outer surface of the bowel presents the appearance of intense inflammation, and may be covered with plastic lymph. As soon as ulceration extends to this covering, perforation impends. The event, however, is often prevented by the adhesion of the part to a contiguous coil of intestine, or retarded by the deposition of solid lymph upon its outer surface. The aperture formed in the peritoneum rarely exceeds three lines.

The ulcers are in proportion to the number and size of the glands affected; if a solitary gland, or cluster of only two or three, the ulcer is a small spot; if a Peyer's patch, there will be a rounded or oval ulcer, from

a quarter of an inch to an inch and a half in width. The ulcers are sometimes confluent. On recovery the ulcers heal, cicatrize, contract, and ultimately form a smooth, depressed surface, thinner and less vascular than the surrounding healthy coat, and devoid of villi.

When the *large intestine* is implicated, the disease is usually confined to the cæcum and the ascending colon. The cæcum is often severely affected, the ulcers being small, round, and uniform in size, unless they become confluent.

The *mensenteric glands* show their sympathy, if not their identity in anatomical structure and function, with the solitary and agminated glands, in becoming inflamed and swollen to several times their natural size. The inflammation may go on to suppuration.

The *spleen* is enlarged, softened, and congested.

The *liver* speedily becomes fatty and enlarged. The mucous membrane of the *gall-bladder* is frequently found inflamed, but rarely ulcerated. The *bile* is thin and almost colorless, commonly acid, and of low specific gravity, and yields a very small proportion of solid matter.

Geographical Distribution.—Enteric fever prevails over all the world.

Causes.—1. *Predisposing. Youth.*—The mean age of 1,772 cases admitted into the London Fever Hospital during ten years was 21. Of these half were between 15 and 25, one-fifth were under 15, less than one-seventh were above 30, and less than one-sixtieth exceeded 50.

Season.—Enteric fever is an autumnal disease, but it exists throughout the year, usually attaining its minimum in spring. It is more prevalent in dry and hot than in cold and wet seasons.

2. *Exciting.—Exhalations from putrid decay of animal matter.*—The two following instances are cited in Dr. Murchison's work on the Continued Fevers of Great Britain. I. Twenty out of twenty-two boys, at a certain school, were seized with fever, accompanied by symptoms of severe gastro-intestinal irritation. Two of the fatal cases were examined, and the usual lesions of Peyer's patches, and the solitary and mesenteric glands, were discovered. The cause was attributed to the opening, two days before the first case of illness, of a drain at the back of the house, which had been choked up for many years, and the distribution of its offensive contents over a garden adjoining the boys' playground.

II. In the year 1838 an epidemic of enteric fever desolated a commune in the department of Arriège. Nearly half the inhabitants were attacked, of whom nearly a third died. The disease was traced to a stagnant pool, the receptable of dead animals and of all the sewage of the district. Three times the pestilence returned, and each time when the wind was blowing over the infected water.

In these cases it is assumed that the poison was conveyed by the air. In the following case, observed by Dr. W. Budd, it appears to have been introduced into the system by water:

III. The inhabitants of thirteen out of twenty-four houses of a certain crescent derived their drinking-water from a well at one end of it; the re-

mainder were supplied with water from another source. At the end of September it was evident that the water from the pump was tainted with sewage. Early in October intestinal fever broke out almost simultaneously in all the thirteen houses using the water.

Some observers, however, attribute the disease to a *specific poison*, contained in the alvine excretions of persons suffering from the disease, and deny that it may be spontaneously generated by putrid animal matter. Observed facts and the few experiments which have been made tend, however, to disprove these views.

Contagion and Infection.—Much doubt prevails whether enteric fever be infectious or not. The question turns on the existence of a distinct specific poison. Positive proof that it may be conveyed from one person to another is wanting, and certainly the majority of patients derive it, on the clearest evidence, directly from one and the same source. Those in attendance on persons suffering from enteric fever do sometimes fall ill of it, but the source of the disease may be present in any house.

Diagnosis.—In the early stage, enteric fever may be mistaken for *typhus, variola, scarlatina*, etc. 1. Great muscular prostration and early cerebral disturbance, with dulness of the senses and mental faculties, mark the onset of typhus; while symptoms, more or less obscure, of gastro-intestinal disturbance indicate the presence of enteric fever; but sickness and diarrhœa may be absent and head symptoms may be prominent from the first in enteric fever. 2. *Abdominal tenderness* about the umbilicus and right iliac fossa; and, 3. *A moist thickly-furred aphthous tongue*, may teach us that the disease is enteric, and not typhus fever. 4. Light ochre-colored fluid stools, sometimes compared to thin pea-soup, are diagnostic of enteric fever. If the motions are kept, as they should be, for the inspection of the physician, they will sometimes afford important indications of the severity and progress of the disease. They will be found to contain membranous flakes, blood, or pus; and the quantity of these will serve to direct our treatment. 5. When the eruption appears the diagnosis is certain. In typhus the rash appears about the fourth day; in enteric not before the seventh. In typhus it consists of a diffused dusky mottling, composed of irregular, uncircumscribed spots, not raised, or only slightly elevated, tending to fade into dirty discoloration, or to become distinct petechiæ. In enteric fever the rash appears much later, never gives a mottled appearance to the skin, and is never confluent. The spots are rose-colored, circumscribed, isolated, and elevated, so as to be distinctly felt by the finger; they always disappear on pressure, and never become petechial. The only difficulty in diagnosis by the skin is that the freckled or mottled skin often seen in dark complexions, and the faint syphilitic maculæ present in others, may so mislead us that we may fail to observe the three or four minute pink papulæ which indicate the presence of enteric fever. 6. The *progress and duration of the disease.* The dusky blush suffusing the head and neck in typhus, contrasts with the circumscribed hectic flush and pinched features of enteric fever. The one disease tends

to death by coma, the other to death by asthenia; typhus kills or shows signs of departure in the second week, enteric fever continues for three or four weeks, and often much longer.

Variola.—If the acute lumbar pain and vomiting be absent and the eruption make its first appearance as a few isolated papules upon the chest and abdomen, the case may be doubtful for a day. For example, a patient has been feeling poorly for a week before he is seen, and then he is in a state of high fever, complaining of headache and great and persistent nausea, but there is neither vomiting nor lumbar pain; he presents a large but faint vaccine scar; the tongue is coated with a dirty-white fur, the abdomen painful on pressure, and there is a distinct gurgling in the right iliac fossa, resulting from free action of the bowels induced by a purgative previously administered. Next day the tongue is dry and brown, and seven elevated rose-colored papulæ, completely resembling those of enteric fever, are scattered over the abdomen and chest. There is no trace of eruption, or of that roughness of the skin which precedes it, on the face or any other part of the body. In this stage it will be impossible to decide whether the case is one of small-pox or enteric fever, and we must defer our diagnosis for a while. A few hours, however, will suffice to decide the matter. In the case referred to, after a copious sweat the papules became harder and more prominent, and others began to appear on the face and limbs, and the case proved to be one of discrete variola.

Scarlatina.—I have shown [1] that the morbid anatomy of scarlet fever is identical with that of the first stage of enteric fever; that the two diseases occasionally coexist or are intercurrent; and that enteric fever is often a direct pathological sequent to scarlatina. Where such close relationship exists we must be guided by the previous history, and the symptoms actually present. (See the diagnosis of Scarlatina, p. 304.)

Chronic Tubercular Peritonitis presents many of the symptoms of enteric fever. The hectic flush, pinched features, abdominal pain, tenderness and gurgling, anorexia and diarrhœa, are all present in this disease, but the tongue is usually moist and clean; there is no eruption, and frequently the abdomen is moderately distended with effusion; moreover, there may be evidence of tubercular deposit in the lungs.

Prophylaxis and Disinfection.—Whenever a case of enteric fever occurs, we must examine into the condition of the drains and cisterns, and the nature of the drinking-water; and ascertain whether there be any offensive accumulation of decomposing animal matter in or near the house. If it can be done speedily and without increasing the nuisance, drains should be cleared and flushed, and offensive accumulations removed. In the absence of all other water, that which is contaminated must be filtered through charcoal and boiled before it is used; but whenever it is practicable the patient should be removed to a healthy locality. The dejections of patients suffering from the disease should be mixed with solution of

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[1] Medico-Chir. Trans., vol. lv.

chloride of zinc, of lime, carbolated lime or carbolic acid, and be speedily removed. Bad odors should be traced at once to their source and the cause removed, or their diffusion prevented by the substitution of stench-traps for open grating. A sufficient fall for the sewage should be provided, and in seasons of drought the drains should be occasionally flushed. Pipes connecting the water-closets with the drain or sewer should be constructed of iron, and always placed on the *outside* of the wall of the house. If made of lead (which is readily eroded by rats) and carried down the *inside* of the house, the apartments are liable to be filled with foul air derived directly from the sewer. It is a common arrangement for the waste pipe of the cistern from which the drinking-water is obtained to pass directly into the soil pipe. In warm weather the cold sewer air rises and occupies the space between the surface of the water and the lid of the cistern: the foul gases are readily absorbed by the water, which becomes thus directly contaminated. This evil is quickly remedied by cutting the waste pipe before it joins the drain, and cleaning out the cistern. Cisterns should be closed, or they may be poisoned by the body of a drowned rat.

When it is necessary to open a drain, or to empty cesspools, disinfectants should be freely used, and the air thoroughly impregnated with free chlorine. Fresh mould, lime, dry sifted ashes, and solution of chloride of zinc should be mixed occasionally with the offensive matter. The chlorine may be evolved from a mixture composed of ℥ iv. each of finely powdered black oxide of manganese and common salt, and ℥ viij. of sulphuric acid diluted with a little water, placed in a deep dish. Sulphate of iron, in powder or solution, is also a commendable deodorant and disinfectant.

Treatment.—In the present state of our knowledge enteric fever must be treated as a local disease. We presume ulceration of the intestines, and fear its worst results. When the patient comes under our notice, inflammatory material has in most cases already been deposited in the intestinal glands, and it is generally too late to adopt an eliminative plan of treatment so as to remove that already formed. If, however, we see the case early, and have grounds enough to form a diagnosis, we may hope to arrest its further progress by judicious treatment. We shall often find that the alvine secretions are retained. In many cases the secretions are defective. The bowels should be relieved by moderate doses of castor oil and by enemata, and then, so long as the motions remain loose and pale, we may administer small and repeated doses of grey powder (gr. ij. combined with gr. iij. to gr. x. Dover's powder) night and morning, and control the diarrhœa if it exceeds three or four motions in the twenty-four hours by an occasional enema of opium (♏xv. tr. opii, et decocti amyli ℥ ij.). This treatment may be continued until convalescence is established.

The diet must be carefully regulated and all solid food rigidly withheld; eggs, milk, and arrowroot in various combinations should form the staple articles of food. The eggs should be lightly boiled, or given in emulsion with coffee or tea. Beef-tea may be frequently given; a few

ounces of red wine may be allowed from the first, and increased to a pint or more during the progress of the disease if the strength fail.

If at any time in the course of the disease the bowels be constipated, ℥ ij. to ℥ iv. of castor oil in combination with ten drops of laudanum may be given. Sickness is best combated by small fragments of ice, or by iced soda-water to which a few drops of dilute hydrocyanic acid have been added. If there be abdominal tenderness or tumidity, linseed poultices should be retained by the slight pressure of a flannel binder on the abdomen. The diarrhœa must be kept within the limits of one or two loose stools a day, and for this purpose we give an occasional dose of chalk mixture. If the abdominal symptoms be severe, with a temperature of 105°, or if it should appear that hemorrhage impends, it will be well to apply a few leeches round the anus. If hemorrhage occur, we must give lead (Form. 157), copper (Form. 160), or gallic acid (Form. 155). Cold fluids should be given, and a bladder of ice placed over the right iliac fossa. Turpentine in x. or xx. minim doses is a valuable remedy in hemorrhage, and it is also useful in relieving the tympanites that often accompanies it. Assafœtida enemata are also useful in tympanites, which is sometimes not only very distressing, but may place the life of the patient in great jeopardy. In such a case a capillary trocar and canula should be passed through the abdominal walls into the distended bowel and the imprisoned air allowed to escape, for laceration of the diseased and attenuated coat of the intestine is very apt to occur in this distended condition.

If peritonitis, with or without perforation, supervene, we must exhibit opium very freely; 1 or 2 grains of the powder may be given every two or three hours: hot fomentations may also be kept applied to the abdomen. Hiccough is often a most painful complication. It may be relieved by the inhalation of chloroform.

Head symptoms and pulmonary complications require the treatment recommended in typhus fever.

During convalescence we must patiently pursue the same plan of treatment as regards diet, and give tonics (Form. 177). As the appetite improves and the stools become less frequent, darker and more solid, we may increase the quantity of food, and substitute another egg and a little fish in place of beef-tea, but solid meat and vegetables should not be taken for a fortnight after the stools have become solid. An egg boiled moderately hard will sometimes be sufficient to produce a recurrence of diarrhœa and bring on a relapse. Cod-liver oil, when the stomach bears it, is useful in removing emaciation.

RELAPSING OR FAMINE FEVER.

Synonyms.—Five or seven days' fever. Epidemic remittent fever. Bilious relapsing fever. Famine fever.

Definition.—A contagious fever of from three to seven days' duration,

abruptly terminating, and recurring after complete apyretic intervals of about a week.

SYMPTOMS.—Sudden and severe rigors, coming on without premonitory symptoms, and when the person is engaged in ordinary occupations. Severe headache and muscular pains soon follow. After an hour or two, intense febrile symptoms appear, with a full, bounding pulse; a dry, burning skin; and the tongue coated with white fur. There is severe pain in the epigastrium and vomiting of bilious fluid or of black, coffee-ground matters. The bowels are constipated and the urine scanty and high-colored. On the third, fourth, or fifth day slight jaundice occurs in one-fifth of the cases. The stools are dark, or even black, and sometimes contain blood. The headache becomes throbbing; the intellect remains quite clear, but there is constant watchfulness and great restlessness.

At the end of five or six days, sometimes earlier, sometimes later, the patient breaks out into a profuse perspiration, often accompanied by diarrhœa, and sometimes by intestinal or uterine hemorrhage; the febrile symptoms are thus brought to an abrupt termination, and the patient feels well, eats, drinks, and may now go about as usual. After a week, or more rarely a fortnight, he suddenly relapses into his former febrile state. The second attack may be less severe than the first, or more severe, and attended with jaundice and delirium. A second intermission occurs, usually after three days, and the patient is again restored to comparative health, complaining only of slight languor. A second or third relapse may occur at intervals of a week, but the patient may recover without a single relapse. In few cases, sudden collapse takes place; the patient becomes cold, livid, and comatose, and dies a few hours after the accession of the disease.

COMPLICATIONS AND CONSEQUENCES.—A *critical diarrhœa,* in some cases slight, in others attended with considerable griping and tenesmus. Occasionally severe, persistent, and fatal *dysentery;* occasionally, also, *chronic inflammation of the mucous membrane of the pharynx and trachea. Menorrhagia* and *abortion* are of frequent occurrence in women.

MORTALITY.—Relapsing fever is not very fatal. Of 441 cases admitted during the first epidemic into the London Fever Hospital, only 11 = $2\frac{1}{2}$ per cent. were fatal; and of the 1,741 admitted during the years 1869–71 only 30 or 1.7 per cent. died. The mortality, however, is greater in some epidemics than in others. In the Scotch epidemic of 1843, it was as high as 4 per cent.

PROGNOSIS.—*Favorable,* if the patient be young and vigorous, and in the absence of complications. *Less favorable,* after middle age, if much jaundice be present, and persistent diarrhœa supervene. *Unfavorable,* if there be suppression of urine.

PATHOLOGY.—No specific lesions of structure are found, but the tissues are usually more or less jaundiced. If gastro-intestinal symptoms have been present, patches of ecchymosed mucous membrane may be found in

any part of the alimentary canal, and the lower part of the *ileum* is usually greatly congested ; but neither Peyer's patches nor the mesenteric glands are in any way diseased. The *liver* is congested, the gall-bladder and ducts are healthy ; but the bile is dark and very thick. The *spleen* is greatly congested and soft. The *blood* is said to contain an unusual number of white corpuscles. The *kidneys* are commonly congested.

Geographical Distribution.—Relapsing fever, like typhus, appears to be more prevalent in Britain and Ireland than elsewhere. Ireland is its favorite habitat, and it has oftener prevailed in Scotland than in England. It has been observed in Silesia, and in 1855 attacked our troops in the Crimea. It has appeared in several parts of North America. It is unknown in the tropics.

Causes.—1. *Predisposing.*—Overcrowding and destitution favor the propagation of relapsing fever. The patients admitted into the London Fever Hospital come from the poorest and most populous districts, and the severest epidemics have occurred in times of famine. 2. *Exciting.*—*A specific poison* generated in the bodies of persons in a state of starvation. Medical men who have had experience of the disease are almost unanimous in the opinion that it is infectious. It successively attacks the members of a family, and spreads through contiguous houses. It appears that the disease has been several times imported into England and Scotland from Ireland. The Scotch epidemic of 1847 was ascribed to the immigration of a large number of destitute Irish ; and epidemics in New York and other North American towns have been referred to the same cause. Medical men and nurses take the disease from patients.

Diagnosis.—Relapsing fever may be mistaken for the other infectious fevers, and for remittent fever. From *typhus* and *enteric fevers* it is distinguished—1. By its sudden invasion, without warning. 2. By the absence of rash. 3. By the complete intermission and relapse. 4. By the absence of severe cerebral symptoms, except in those rare cases of relapsing fever in which collapse and coma come on. The early symptoms of enteric fever are obscure and the febrile symptoms slight. Vomiting, jaundice, and enlargement of the liver and spleen are often present in relapsing fever.

Remittent fever occurs in malarious districts and is non-infectious. *Variola.*—Lumbar pain, vomiting, and high fever attend the onset of this disease as well as of relapsing fever ; but all uncertainty ceases with the appearance of the rash.

Treatment.—This should be directed to the relief of the congestion of the internal organs. Vomiting may be encouraged for a time ; or, if absent, it may be induced (Form. 201). Cholagogue purgatives (Form. 250) should then be given. If there be much tenderness or pain in the hypochondria, leeches may be applied. The headache may be relieved by a bladder of ice or a stream of iced water. Perspiration may be promoted by saline diaphoretics.

We must carefully note the quantity of the urine, and if scanty we must

resort to the treatment required in such a case (see *Suppression of Urine*). During the intermission care must be taken to secure the due action of the bowels; and the secretion of the liver should be encouraged. An occasional dose of calomel will be of much service, if dysenteric symptoms be absent. Tenesmus requires relief by an opiate suppository or enema.

Quinine with acid, in full doses, should be given till the strength is restored.

CHAPTER IV.

FEVERS—*Continued.*

DEFINITION.—Contagious diseases, attacking a person, for the most part, only once, beginning with fever and followed, after a short and nearly definite interval, by a specific cutaneous eruption,

VARIOLA,	Small-pox.
VACCINA,	Cow-pox.
VARICELLA,	Chicken-pox.
RUBEOLA,	Measles.
SCARLATINA,	Scarlet Fever.
DIPHTHERIA,	Diphtheria.
PESTIS,	Plague.

VARIOLA—SMALL-POX.

DEFINITION.—A contagious and infectious disease, setting in with severe febrile symptoms, followed by an eruption which passes through the successive forms of papule, vesicle, and pustule in about eight days.

VARIETIES.—1. Variola discreta, distinct small-pox. 2. Variola confluens, confluent small-pox. 3. Variola hæmorrhagica (probably the "Flox" of the early London Bills). 4. Varioloid, modified small-pox. Sydenham and Frank have also described a "Variola sine eruptione."

1. VARIOLA DISCRETA—DISTINCT SMALL-POX.

SYMPTOMS.—Rigors, lassitude, headache, severe lumbar pain, with extreme weakness in the back, and a white furred tongue, nausea, vomiting, and tenderness of the epigastrium. Drowsiness, and even coma, and in infants convulsions, are present in some cases. These symptoms are followed by inflammatory fever, with full, frequent pulse, hot and dry skin, diminished secretions, restlessness, and in some cases, delirium ; symptoms that continue till the eruption, preceded perhaps by sweating, appears. In most cases the fever now subsides.

At the end of *forty-eight hours* from the first occurrence of rigors, but sometimes earlier, and sometimes as late as the fourth day, the rash appears on the face and forehead as distinct minute papules, about the size of a pin's head, sensibly elevated above the surface of the skin, and feeling like small shot beneath the finger.

During the *third* day, or the *third* and *fourth* days, the eruption extends over the rest of the face, and successively involves the neck, shoulders, hands and arms, trunk, legs and feet, being usually most abundant on exposed parts, and rose-colored on covered parts.

About the *fifth* day, a minute circular vesicle, depressed in the centre, filled with a colorless fluid, and having an inflamed areola or margin, forms on the top of each pimple. The eruptive fever now rapidly subsides.

About the *sixth* day, there is some swelling of the throat, with difficulty of swallowing, hoarseness, and a flow of viscid saliva ; the inflammation, or the rash itself, has extended to the mouth and fauces, where it can be seen as small, round, white spots. The eyelids and inner surfaces of the genital organs are similarly affected.

By the *eighth* day the central depression has disappeared, the areola attained its full size, and the vesicles become purulent. The face swells ; the eyelids are often so enlarged as to close the eyes ; and the mouth, nose, and fauces are covered with pustules.

By the *eighth* or *ninth* day the pustules have attained their full size, and have a brown central spot. The inflammatory areola subsides, the swelling of the face disappears.

After this time the pustles break, and their contents ooze out, and dry into crusts, which soon fall off, and leave the skin beneath of a purplish-red color, which often lasts for weeks. The swelling of the hands and feet gradually subsides, and about the seventeenth day the patient is convalescent. In severe cases permanent white scars are left on the face and other exposed parts.

The time occupied by the change from pimple to pustule is called the period of *maturation.* At some part of this stage, according to the amount of eruption, but generally about the eighth day, *secondary fever* sets in, characterized by extreme restlessness, sleepless nights, a frequent and quick pulse, dry brown tongue, scanty and high-colored urine, and by delirium, especially at night. The bowels are usually constipated, sometimes obstinately so throughout.

2. Variola Confluens—Confluent Small-pox.

Symptoms.—This differs from the distinct form only in degree. The eruptive fever is more intense, and increases up to the period of maturation. The *secondary fever* is also more severe, and often assumes the typhous character. Coma and delirium are more frequent concomitants ; and severe diarrhœa sometimes sets in.

The rash is also irregular in its appearance and progress. It is usually preceded by a red efflorescence on the swollen skin, from which the pustules emerge on the second day as small red points. Maturation takes place earlier ; but the pustules, instead of being globular, are flat and irregular, and may contain, instead of pus, a brownish ichor. The

inflammation extends to the subjacent cellular membrane, and sometimes ends in extensive sloughing. The swelling of the face and salivation commence early, and rise to a great height. The fever, though it generally abates somewhat, does not cease on the appearance of the rash; and about the ninth day there is a remarkable exacerbation, attended in some instances with all the worst symptoms of the typhous condition. The eruption turns livid or black; petechiæ and passive hemorrhages, bloody urine or dysentery, and sordes on the lips and teeth, make their appearance; and the patient often succumbs on the night of the eleventh day in convulsions or coma. In persons who recover, the scars are much deeper and more extensive than in the milder form.

3. Variola Hæmorrhagica—Black Small-pox.

This variety is distinguished by an outburst of blood upon the free surfaces of the body, on the third or fourth day of the disease, simultaneously, in fact, with the eruption of the papules, the development of which, being thus directly interfered with, is wholly arrested. At first the skin is partially or generally spotted with bright red petechiæ, varying in size from a pin's head to three-fourths of an inch in circumference. There is profuse hemorrhage from the vagina, the intestines, the mouth or the nose; hæmaturia, too, is usually present, and the conjunctivæ are completely ecchymosed. The mind is clear and calm. The petechiæ increase in size, and become dark purple, and the hemorrhage continuing, the patient rapidly sinks and dies an easy, and, to him, an unexpected death, on the fourth, fifth, or sixth day of the disease.

Morbid Anatomy.—The left heart is usually found empty, and the right congested with dark, softly clotted blood. The lungs, spleen, and mesenteric glands are congested. Blood-clots will be found in the pelvis of the kidney, and in the intestines, where they are derived from patches of severe ecchymosis. The large intestine is usually very severely congested, and maculated with petechiæ like the skin. The uterus and vagina are occupied with blood-clots; and patches of ecchymosis may be observed upon the serous membranes.

Diagnosis.—A few cases of this variety occur during every severe epidemic of small-pox. When once seen it is readily known; but as death occurs before the rash is developed, the true nature of these cases has been frequently overlooked.

The diseases with which it is liable to be confounded are purpura and scarlatina. The eruption of blood within the skin, and the profuse bleeding from the mucous membranes assimilate it to the former of these maladies; while the severe premonitory febrile symptoms, and the bright, copious, and often very fine petechial eruption, have a great resemblance to the petechial variety of scarlatina.

On carefully examining the skin and mouth, with the eye and the finger, we shall rarely fail to discover the true nature of the disease. A

few white pustules may be found on the soft palate, and if there be no distinct papules observable on the skin, the finger will usually detect them as hard points beneath the cuticle. Here and there a few papules may have reached the depressed stage.

Treatment.—The free use of stimulants, and solution of perchloride of iron, ♏xl. of which may be given every two or three hours.

4. Varioloid—Modified Small-pox.

Small-pox may be rendered less severe, and be otherwise changed in character by three causes: A previous attack, inoculation, and vaccination.

Small-pox modified by a previous attack, by inoculation, or by vaccination, has the following leading characteristics: The eruptive fever, though often intense, lasts generally one day, or even less. The patient complains perhaps of indisposition in the afternoon, passes a restless night, and in the morning finds the rash out, and the fever gone. The first places in which the rash appears are generally the wrist and alæ of the nose, and a pimple in the latter situation will often give the clue to the nature of the disease. The eruption itself runs a shorter course, is rarely confluent, and has not the uniformity of the regular disease. A few of the pustules, though small, are well formed, and have the central depression. Several of the pimples do not become vesicles, and the vesicles themselves shrivel (*Horn-pock*), or are unusually persistent, and transparent (*Pearl-pock*). All the stages of the eruption may be seen on the body at the same time, and all imperfect. As soon as the rash appears the patient is well, unless it happen to be so extensive as to give rise to secondary fever.

Cause.—A specific poison, emanating from persons laboring under the disease, or from clothes worn, or things used by them. The variolous matter may be introduced into the system by inoculation, by the scab, or by cotton wool soaked in the matter and inserted in the nostril.

Prognosis.—*Favorable.*—The pustules distinct; the march of the disease regular; the form modified; the subject healthy. The period of childhood and youth. *Unfavorable.*—The confluent form; the fever assuming the typhous condition, and the pustules becoming flattened, livid, or interspersed with petechiæ. The sudden disappearance of the rash, with subsidence of the swelling of the face or extremities; depression of the pustules, followed by great prostration of strength, universal pallor, great anxiety, oppression at the chest, syncope, convulsions, coma, or delirium. A sudden rise in the pulse; great dyspnœa. Excessive vomiting setting in before the rash, and continuing after its appearance. Blood in the urine and other secretions. Complications with visceral disease, such as inflammation of the brain, throat, larynx, lungs, or alimentary canal, and suppurations in these viscera, or in the joints. Infancy and advanced age.

The patient's fate is usually determined in the interval between the

eleventh and seventeenth day, rarely during the primary fever. The secondary fever is sometimes terminated by a critical diarrhœa.

Sequelæ.—Abscesses, ulcers, boils, suppuration of the glands of the neck, sloughing of the skin, erysipelas, suppuration of the joints, ending in permanent lameness; ophthalmia, followed by blindness from opacity of the cornea; deafness, following suppuration of the internal ear; suffocation from swelling of the glottis; inflammation of the serous membranes of the chest and abdomen; pleurisy, terminating in empyema; inflammation of the lungs; hæmoptysis; hæmaturia, inflammation and suppuration of the kidneys; in females, menorrhagia; in pregnant women, abortion; melancholia followed by mania. During convalescence, patients may be attacked by other prevalent diseases, such as typhus, erysipelas, and hospital gangrene.

Morbid Anatomy.—On the skin, the rash as described. On the conjunctiva of the eye, on the lining membrane of the air-passages, on the mouth, tongue, nostrils, palate, and fauces, on the prepuce and labia, small patches of false membrane, or of detached epithelium, or denuded spots of mucous membrane, or actual pustules. In rare cases, these appearances extend into the bronchial tubes and through the whole length of the intestines. Inflammation in various internal organs; the texture of the viscera softened; rapid putrefaction after death.

Diagnosis.—The sudden attack, the intense pain in the head, back, and loins, the sickness, the absence of the local affections of the other febrile exanthemata, the prevalence of the disease at the time, and the exposure to contagion, are strong probabilities in favor of small-pox; and the regular successive changes in the eruption are conclusive. Before the appearance of the rash, and until it has assumed a characteristic form, the diagnosis may prove difficult. A typical case may be mistaken for *relapsing fever* (page 284); a modified form for *enteric fever* (page 281). During the primary fever there may be profuse sour-smelling perspiration, and general muscular pains, and this combination may be mistaken for *rheumatic fever*. The following are cases in point: 1. A profuse sour-smelling sweat had lasted forty-eight hours before the rash appeared; and the muscular pains continued two days longer. 2. The eruption was preceded by a copious, fiery crimson, finely spotted petechial rash, covering the trunk and upper parts of the limbs, and confluent at the flexures of the arms and thighs into vivid crimson patches, surrounded by distinct crowded petechiæ. The rest of the skin was dusky crimson, and the surface intensely hot. Two rose-colored papules were noticed on the chest. The lumbar pain was intolerable. Twelve hours afterward the eruption began to appear; and, though quite disproportioned to the petechial rash, the disease was confluent. At the outset such a case might be mistaken for *typhus*.

It is not always easy to distinguish the papular stage of small-pox from an acute attack of *syphilitic lichen;* but the papulæ on the alæ of the nose, upper lip, and wrist are highly characteristic of variola.

Mortality.—This is influenced by the patient's age, the severity of the disease, its previous occurrence, and the performance, or otherwise, of vaccination. Childhood and old age both predispose to a fatal issue; and the danger, as in all analogous diseases, increases with the age. According to Mr. Marson, patients of all ages die at the rate of 50 per cent. in the confluent form; 8 per cent. in the semi-confluent; and 4 per cent. in the discrete variety. Inoculation, when performed with skill and care, was followed by a very low mortality.

Vaccination appears to afford a better protection against a fatal issue than a previous attack of small-pox itself.

Annual fluctuation considerable: *e. g.*, in 15 years (from 1840 to 1854) the deaths in London, in a million inhabitants, were as high as 890 in 1844, and as low as 225 in the year preceding, and only 87 in 1853. This fluctuation is in part due to recent legislation; but has always been a marked feature of the disease.

Laws of Infection.—Communicated by contact or through the air; by the living and dead body; by the contents of the vesicles and pustules; by the dried scabs; or by substances imbued with the variolous matter. Infecting distance considerable—from 30 to 50 feet, or more. The period at which a patient begins to communicate the affection, and at which he ceases to be dangerous to others, has not been ascertained. It rarely occurs twice in the same person; about one per cent., it is believed, are liable to a second attack. It may attack the fœtus in utero. *Period of incubation.*—Usual duration, twelve days; limits, ten to sixteen days.

Treatment.—*Before the appearance of the eruptive fever*, the treatment will be the same, whatever may be the nature of the impending disease. An emetic (Form. 200), followed by a brisk saline aperient (Form. 239), to remove any offending matter from the alimentary canal; the antiphlogistic regimen, if inflammatory symptoms run high; stimulants in extreme nervous depression; opium in great nervous irritability; local bleeding and stimulants in congestion, to promote reaction, and to relieve the circulation. *During the eruptive fever* the fever may be moderated by exposing the body of the patient to a cool atmosphere, by cold drinks, as lemonade, toast-water, soda-water, etc.; at the same time giving saline aperients, to keep the bowels loose. Cold affusion may also be used with advantage when there is much heat of skin; but cold or tepid sponging is to be preferred.

After the appearance of the eruption, the indications are:

I. To moderate the fever when violent. II. To support the strength when deficient. III. To subdue local inflammation and relieve occasional symptoms.

(I.) As the fever at once subsides on the appearance of copious perspiration, stimulant diaphoretics (Form. 1 or Form. 210) should be given every four hours; and a full dose of opium may be given at bedtime, if the patient be restless. The apartment must be kept cool and well ventilated.

(II.) If the strength fail, it must be supported by tonics or stimulants. Quinine, or the tonic infusions, in the lesser degrees of weakness, wine and ammonia in the greater.

(III.) Ophthalmia, if severe, will require leeches to the temples; if milder, solution of nitrate of silver (gr. v.—℥ i.). Olive-oil, cold cream, vaseline, or simply tepid water, are grateful applications to the swollen and irritable skin.

If the throat be attacked, and there be difficulty in swallowing, leeches may be applied to the neck, and an astringent gargle used.

Internal inflammation must be treated on general principles, but blisters and counter-irritants are contra-indicated, except in the discrete form of rash.

Obstinate vomiting, which sometimes proves both troublesome and dangerous, is best treated by effervescent salines, with a few drops of laudanum. If there be tenderness at the epigastrium, a warm poultice may be applied, preceded, in severe cases, by a few leeches.

If there be a tendency to the typhous condition, the treatment recommended in that stage of continued fever should be resorted to.

If, after the eruptive fever has passed away, the patient suffer from profuse sweats, a cool regimen, and the dilute mineral acids in combination with tonics (Form. 122), should be prescribed.

Diarrhœa, when excessive, should be checked by the usual remedies (Form. 148).

When the eruption suddenly recedes, or the pocks sink and shrink, and alarming symptoms, such as rigors, convulsions, or delirium, supervene, blisters should be applied to the nape of the neck, and sinapisms to the feet and legs. The cold douche to the head, while the body is in a warm or vapor bath, may be used with great benefit.

The *secondary fever* requires the treatment of continued fever of the same type and degree of severity. When much irritation is present, full doses of opium are indicated.

In favorable cases little treatment is required beyond an occasional saline aperient, and the avoidance of an excess in diet.

In all cases the warm bath should be used repeatedly during the convalescence.

Prevention of pitting.—All the means recommended for this purpose consist either (1) in protecting the parts from the air; (2) in letting out the contents of the vesicles before the change from lymph to pus; or (3) in exciting common, in place of specific, inflammation.

1. To protect the skin from the air, and to give it support, equal parts of collodion and castor-oil may be painted over the face in males, and the face, neck, and arms in females.

2. Puncturing the full vesicles with a fine needle, and absorbing their contents with soft cotton, is an effectual method, but it is very tedious.

3. Nitrate of silver, in substance or in strong solution. Tincture of iodine may be applied to the pustules with advantage.

VACCINA—COW-POX, VACCINATION.

Synonyms.—Vacciola, vaccinia, kine-pox, vaccine disease.

Vaccination.—*Mode of performing the operation.*—Having charged the point of the lancet with recent lymph, that contained in tubes, or with the moistened lymph preserved on glass or points, pick up the skin over the insertion of the deltoid with the point of the instrument, and inclining it toward you, make a slight to and fro movement of the instrument, so as to insinuate the point underneath the skin obliquely, or almost flush with the surface, so as to avoid too free a puncture and any bleeding. After withdrawal of the lancet, only a scarcely perceptible red point should be apparent. To insure success a little more lymph may be rubbed in with the flat edge of the lancet, or a slightly moistened point may be inserted into the puncture. Three such punctures should be made on either arm.

Description of the Areola.

When the operation is properly performed, the course of the eruption is somewhat as follows:

Second day.—Small red points appear, which feel hard, but when viewed with a magnifier, are seen to be vesicular. *Third* or *fourth day.*—The spots larger and more perceptible. *Fifth day.*—Small pearly circular or oval vesicles corresponding to the punctures, and containing a minute quantity of transparent fluid. *Eighth day.*—The vesicle has its perfect form and full size, with depressed surface and raised margin. On the evening of this day the vesicle begins to be surrounded by a circular rosy areola, the skin for some distance round it is tense and painful, and there is slight febrile disturbance. *Ninth* and *tenth days.*—The areola enlarges, and is often accompanied by extensive erythema of the arm, and sometimes by a lichenous eruption over the whole body. *Eleventh day.*—By this time the vesicle, if it have not been opened, has burst, the areola has begun to fade, the centre of the vesicle is covered with a brown scab, which hardens and blackens, and about the *twentieth* day falls off, leaving a deep indentation of a circular form, with as many pits as there were cells, and proportioned in size to the previous inflammation. Unless all these appearances follow the operation, the vaccine disease has been imperfectly communicated, and revaccination is absolutely necessary.

Precautions.—The best time for taking the lymph is from the fifth to the eighth day; after this it cannot be depended on. The disease will not be properly communicated if there be any other severe malady present, or if the vesicle be disturbed by friction. Boils, pustules, and leprous and impetiginous eruptions may succeed the vaccine disease; but seldom if the child's health is good at the time. Such eruptions are readily cured by mercurial alteratives and gentle aperients.

In years of epidemic small-pox, vaccination, in some cases, and espe-

cially in adults, gives rise to severe local and constitutional effects, consisting perhaps of successive crops of painful boils.

Infants may be vaccinated at any time after the sixth week. The age of three months is to be preferred, if the child be healthy.

Revaccination may be assumed to be unnecessary in a person who can show three well-marked excavated scars. But as it may be very generally practised without inconvenience, it is well to resort to it when small-pox is epidemic.

The best argument for revaccination is the result of that operation in the Prussian army. In the year 1841 nearly 45,000 soldiers were revaccinated, and though, before that time, varioloid disease was very prevalent in the barracks, only eight cases occurred afterward.

As it is most important that the amount of protection afforded by vaccination should be understood, the following tables are given:

EPIDEMIC IN SCOTLAND, 1818–19.—(DR. JOHN THOMPSON.)

	Unprotected.	Small-pox Second Time.	Small-pox after Vaccination.
Cases, ...	205	71	310
Deaths, . . .	50	3	1
Proportion, . . .	1 in 4	1 in 24	1 in 310

The following table, reduced to a uniform scale of 15,000, is founded on the facts recorded by M. Favart during the small-pox epidemic at Marseilles in 1828. The estimated population under thirty years was 40,000, of whom 30,000 had been vaccinated, 2,000 had had casual small-pox, or small-pox by inoculation, and 8,000 were unprotected.

MARSEILLES.—EPIDEMIC OF 1828.—(M. FAVART.)

	Unprotected.	Previous Small-pox or Inoculated.	Vaccinated.
Estimated number, ...	15,000	15,000	15,000
Attacked, ...	7,500	150	2,000
Died, ...	1,875	30	10
Proportion attacked, ...	1 in 2	1 in 100	1 in 15
Deaths to attacks, ...	1 in 4	1 in 5	1 in 100

In the Small-pox Hospital, during the eleven years 1841–51, there were 4,091 admissions with small-pox, distributed as follows:

	Patients.	Deaths.	Mortality per cent.
Not alleging any protection, ...	1,722	629	37
Alleging prior small-pox, ...	36	6	17
" vaccination, but no scars, . . .	166	56	34
" vaccination, and scars, . . .	2,167	147	7

The plain inference from the facts is, that vaccination, though a less complete protection against attacks of small-pox than a previous attack, or inoculation, is the best known protection against a fatal attack.

VARICELLA—THE CHICKEN-POX.

Synonyms.—Swine-pox, Bastard-pox, Gland-pox, Crystalli.

Definition.—A contagious and infectious disease ushered in by slight febrile symptoms, followed by a vesicular eruption which generally runs its course in five days.

Symptoms.—Within twenty-four hours after slight symptoms of fever, such as lassitude, loss of sleep, wandering pains, and loss of appetite, a rash appears, consisting of small reddish pimples, resembling the first appearance of small-pox, first on the back. By the *second* day, the red pimples have become small vesicles, containing a faint yellow fluid, transparent or colorless. On the *third*, the vesicles arrive at maturity. Soon after, the tender vesicles burst, or are ruptured, or they collapse and dry; in either case, a thin yellow or dark brown scab is formed. Pus is never formed, as in variola. Generally before the *fifth* day the eruption disappears, leaving behind it no cicatrix or mark.

Cause.—*Predisposing.*—Infancy and childhood. *Exciting.*—Contagion.

Diagnosis.—*From variola.*—By the slight fever; the short interval (twenty-four hours) between the first symptoms and the appearance of the rash; by the pimples first appearing on the back; by the form of the eruption, which is never pustular nor depressed; by the separation of the scaly scabs about the fifth day, when the eruption in variola is only just completed. From *modified small-pox* by the entire absence of pits.

Prognosis.—Highly favorable.

Laws of Infection.—The infection less powerful than that of the other febrile exanthemata, the infecting distance probably small, and second attacks rare. The latent period considerable.

Treatment.—Medicine is rarely needed. Gentle saline aperients with small doses of tartar-emetic may be prescribed, if the fever exceed its usual moderate standard. The treatment to be terminated by a warm bath.

RUBEOLA—THE MEASLES.

Synonym.—Morbilli.

Definition.—A continued contagious and infectious fever, commencing with catarrhal symptoms, and followed, about the fourth day, by a peculiar eruption of the skin.

Varieties.—1. Rubeola vulgaris. 2. Rubeola maligna. 3. Rubeola sine catarrho.

1. Rubeola Vulgaris.

Synonyms.—Morbilli vulgaris; Morbilli mitiores.

Symptoms.—The first symptoms are those of catarrh. After rigors and flushes, lassitude, heaviness, pain in the head, and drowsiness, there are ringing cough, hoarseness, difficulty of breathing, frequent sneezing, itching

of the face, smarting of the eyes, and swelling of the eyelids, with copious secretion of watery fluid from the eyes and nostrils ; nausea or vomiting, thirst, furred tongue, frequent pulse, and the general symptoms of fever. On the *fourth*, but sometimes as early as the third, or as late as the fifth day, small red circular spots, resembling flea-bites, appear, first on the face, neck, and arms, then on the trunk, and afterward on the legs. The three crops of the eruption are usually separated by an interval of twenty-four hours. The spots are generally in crescentic clusters, of a deep red color, do not rise into visible pimples, but are found by the touch to project slightly above the surface. Sometimes, however, the spots are distinctly papular, and, at the height of the rash, vesicular. About the *eighth* day, but sometimes as early as the *fifth* or *sixth*, the color of the rash begins to fade ; first upon the face, neck, and arms, then upon the trunk, and lastly on the legs ; and in another day or two the eruption entirely disappears, with a mealy or furfuraceous desquamation of the cuticle. At this period diarrhœa sometimes sets in. The fever and catarrhal symptoms subside at the same time, and the expectoration changes from a transparent mucus to an opaque yellowish-white sputum.

The catarrhal and febrile symptoms sometimes subside when the rash appears ; but in most cases they increase, the cough becoming more troublesome, and the breathing short, frequent, and wheezy. The stethoscope reveals bronchitis more or less extensive, and sometimes pneumonia.

The usual duration of the disease is from nine to twelve days. The convalescence is often tedious.

2. Rubeola Maligna.

Synonyms.—Morbilli nigri ; Morbilli graviores.

In this form the first symptoms are more severe, and the disease soon assumes the typhous character. The eruption appears early, but irregularly, alternately receding and reappearing. It assumes a dark or livid hue (*rubeola nigra*), and is often interspersed with petechiæ. The fauces are of a dusky red or claret color. There is great tenderness in the abdomen, with dark offensive stools ; croup and severe pneumonia supervene with delirium ; and the patient dies asphyxiated, exhausted by diarrhœa, or comatose.

3. Rubeola sine Catarrho.

The primary fever and eruption in a few cases occur in a mild form, without catarrhal symptoms. On the other hand, a fever resembling in character and duration that of measles, may take place with catarrhal symptoms, but without the rash.

Cause.—*Predisposing.*—Infancy and childhood ; but the disease may occur at any age. The winter and spring seasons. *Exciting.*—A specific contagion.

Mortality.—This varies from 1 in 3 to 1 in 40, the average being 1 in 15. Annual fluctuations considerable; *e.g.*, 1,122 deaths in London in a million inhabitants in 1845, and only 249 in 1852.

Laws of Infection.—Spreads by fomites and through the air; and may be communicated by blood from the arm, or by serum from vesicles. It very rarely occurs a second time. The period of incubation is probably from 6 to 16 days; and it is also probable that the disease may be communicated during the primary fever.

Diagnosis.—From *Scarlatina*, by the darker hue of the rash, the crescent arrangement of the patches, and its appearance, as a rule, on or about the fourth, instead of the second day. Also by the marked catarrhal symptoms, and absence of severe throat affection; by its shorter course, and less fatal character. From *Roseola*, by the catarrhal symptoms; and greater severity of the fever. From *Typhus*, see p. 274.

Prognosis.—Favorable, excepting in the malignant form. *Favorable.*—The febrile and other symptoms slight; moderate diarrhœa; epistaxis; early and free expectoration; a moist skin when the eruption appears. *Unfavorable.*—A high degree of fever; hot and dry skin; hurried and difficult breathing; flushed countenance. The fever increasing after the appearance of the rash, and assuming the hectic, or typhous form; great pain in the head and eyes; shooting pains in the chest; symptoms of pneumonia or croup; convulsions; a rapid and small pulse; co-existence with whooping-cough; delirium, or coma; continued diarrhœa or vomiting; a livid hue of skin.

Sequelæ.—Pneumonia, œdema of the lungs, pleurisy, croup, bronchitis, phthisis; diarrhœa; enlargement of the mesenteric glands; ophthalmia; abscesses in the ear; swelling and suppuration of the parotid, sub-maxillary or cervical glands; aphthæ and gangrene of the mucous membrane of the mouth; whooping-cough.

Morbid Anatomy.—Marks of inflammation in the internal organs, especially the air-passages and lungs.

Treatment.—*Indications.*—I. To diminish inflammatory action. II. To relieve urgent symptoms.

(I.) The temperature of the sick-room should be maintained at about 70° Fahr. and kept free from draughts of cold air; the diet should consist of thin gruel, milk and water, or beef-tea containing a little bread or vermicelli.

Perspiration should be encouraged, and bronchial or pneumonic irritation alleviated by the application of large hot light-bread poultices, with or without a little mustard, to the throat and chest.

The bowels should be freely relieved by an active purgative, such as from gr. xv. to gr. xl. of compound jalap powder.

When the febrile symptoms run high, and especially when local inflammation threatens, tartar-emetic must be given in nauseating doses at short intervals.

(II.) In milder cases saline refrigerants and diaphoretics in combination with squill or ipecacuanha (Form. 222) will suffice.

Lemonade, linseed-tea, a decoction of figs in milk, or barley-water, should be liberally supplied, as they are grateful to the inflamed mucous membrane. Inhalations of steam may be used with advantage.

If need be, we must administer a combination of henbane and opium to counteract restlessnsss and encourage sleep (Form. 80).

To relieve heat, and dryness of the skin, a warm bath is indicated.

Pneumonia, diarrhœa, whooping-cough, or other complication, must be treated according to the urgency of the symptoms.

The malignant form must be treated as low fever (see *Typhus*), with special reference to the bronchial affection.

When the eruption disappears before the proper time, and convulsions, great anxiety, or delirium take place, sinapisms or blisters must be applied to the chest and feet, ammonia, camphor, ether, and hot wine and water being given freely and at short intervals.

During convalescence, the diet should be nutritious, the bowels regulated, and the dress warm. Great care should be taken to avoid exposure to cold and to drafts of cold air.

Prophylaxis.—The same precautions are required as in the case of other contagious maladies. Inoculation with blood taken from the patches, with the serum of the vesicles, when the eruption is vesicular, or with the secretion of the conjunctiva, has been practised with some advantage. The cases which have followed inoculation have been of a mild type.

SCARLATINA—SCARLET FEVER.

Definition.—A continued contagious and infectious fever, with inflammation of the fauces, and a scarlet rash on the skin, setting in on or about the second day, and terminating in desquamation.

Species.—1. Scarlatina simplex. 2. Scarlatina anginosa. 3. Scarlatina maligna. 4. Scarlatina sine eruptione.

1. Scarlatina Simplex.

Symptoms.—This form is characterized by the slight affection of the throat. It sets in with the usual symptoms of fever—cold chills, shivering, nausea, and sometimes vomiting, with pain in the head, back, and limbs, thirst, hot skin, frequent pulse, restlessness, and sleeplessness. On the *second* day, in most cases a bright scarlet efflorescence shows itself on the face, neck, and arms, extending over the trunk and limbs. At first it consists of innumerable red points, which soon coalesce, and in a few hours the redness becomes universal, being peculiarly distinct at the bends of the joints, on the chest and abdomen, the hips and loins. The color disappears on pressure, but immediately returns. After *one* or *two* days, the efflorescence again becomes partial, is arranged in large irregular patches, and does not disappear on pressure. The skin is rough to

the touch, and in some cases studded with small miliary vesicles. The rash generally begins to decline on the *fifth*, is very indistinct on the *sixth*, and wholly disappears by the *eighth* day. Desquamation generally begins on the parts first affected about the end of the *fifth* day, and soon extends to the entire body. The cuticle separates as a scurf from the trunk and limbs, and in large scales from the hands and feet. This is often accompanied by great itching, irritation, and tenderness.

The rash is preceded or accompanied by a sore throat, and some difficulty of swallowing; and, on inspection, the tonsils are found slightly enlarged and inflamed, and coated with a white, tenacious mucus. The eye-lids, lips, edges of tongue, soft palate, pharynx and nostrils are also inflamed. The papillæ of the tongue are elongated, and project as bright-red points through the white mucous covering; or the whole tongue is bright-red with prominent papillæ. In the first case it resembles a white strawberry; in the second a red one.

The fever does not abate on the appearance of the rash, but subsides with it, leaving the patient, in most cases, very weak. The pulse is generally very frequent (120 or 130), and the skin very hot (105°, 106°, and even 112° Fahr.), and there is usually some increase of fever at night, with slight delirium, even in favorable cases. The bowels are frequently confined; nausea and vomiting are not uncommon; and the urine is often scanty and high-colored, and in the decline of the disease, generally contains albumin.

Although the eruption in scarlet fever usually occurs on the second day, there are many exceptions to the rule. On the one hand, the rash may appear much earlier than the second day, as in a lad of sixteen, who first fell ill at five o'clock in the evening, and had the eruption full out upon him before midnight. On the other hand, during the prevalence of scarlet fever, many mild cases occur in which there is slight sore throat, and a suspicious appearance of tongue, with little disturbance of health for three, four, or five days, at the end of which time the rash makes its appearance. These cases present some difficulty; but however slight the other symptoms may be, there is always during this latent period a very frequent, full, and peculiarly compressible pulse. Whenever this pulse exists, some febrile disease (and scarlatina, if rife at the time) may be confidently looked for. (G.)

2. Scarlatina Anginosa.

Symptoms.—Those of scarlatina simplex, in an aggravated form, with a more severe affection of the throat and parts adjacent.

The submaxillary glands are enlarged and painful to the touch; the soft palate, uvula, tonsils, and pharynx, as far as the eye can reach, are of a florid red color, the tonsils and soft palate much swollen, and the uvula enlarged and lengthened. A thick mucus collects at the back of the throat, and proves very troublesome to the patient, and specks are often observed

resembling the slough in cynanche maligna; yet ulceration is rare, and when it does occur, superficial. Smooth, yellow patches of fibrinous exudation frequently form over the inflamed, excoriated, or ulcerated tonsils or pillars of the fauces, in all respects resembling that of diphtheria. The mouth is opened with difficulty, there is great pain in swallowing, and liquids often return through the nostrils. The tongue is very red, and its papillæ very prominent. The inflammation may extend to the mucous membrane of the nose, and through the Eustachian tube to the ears, causing a thin, purulent discharge from those parts; the skin is of a deeper color, and the eruption spreads more rapidly.

Often, after a few days' amendment, an unaccountable languor and debility supervene; the pulse is quickened; the sleep disturbed; the appetite lost; the secretion of urine nearly suppressed; and dropsical effusions take place into the limbs, abdomen, or chest, or in several parts at the same time.

3. Scarlatina Maligna.

Symptoms.—The tonsils, though less swollen than in scarlatina anginosa, are redder, and soon become the seat of rapid, extensive, and deep ulcers, interspersed with gray sloughs, which are detached slowly, leaving ragged sores, which heal with difficulty. Ashy ulcers also form on the interior of the cheek. The inflammation, extending into the nostrils, causes a thin, acrid discharge, which inflames and excoriates the lip and chin, and the salivary glands are much swollen and inflamed. The eruption appears late, in irregular patches of a paler color, which sometimes disappear suddenly. The other symptoms resemble those of typhus.

4. Scarlatina sine Eruptione, or S. Latens.

Sometimes the disease assumes so mild a form as to escape detection till some sequela, such as general anasarca, shows that the slight indisposition, "a feverish cold," was an attack of scarlatina. We must be careful not to overlook such cases; as want of proper nursing and precautions may entail consequences as bad as those of a severe form of the disease.

It is not uncommon for those who have had scarlet fever in its usual form, when again exposed to the contagion, to have the characteristic sore throat succeeding the usual premonitory symptoms, but no eruption. Desquamation of the cuticle, however, occurs in some of these cases when no distinct rash has appeared on the skin. Such persons may communicate the common form of the disease.

Duration of Scarlet Fever.—In ordinary cases the first stage (from the commencement to the appearance of the rash) occupies twenty-four, forty-eight, or seventy-two hours; the second stage (from the appearance of the rash to its subsidence) from six to eight days, and the third stage (from the disappearance of the rash till recovery) from a few days to two

or three weeks. Entire duration, from eight days to thirty days, or more.

Sequelæ.—Acute desquamative nephritis, with anasarca, and occasionally with other dropsical affections, such as ascites, hydrothorax, hydrocephalus, and hydropericardium—these often follow the mildest attacks. Acute rheumatism, with endo- and pericarditis. The other sequelæ show themselves mostly after attacks of scarlatina anginosa or maligna. They are the following: Pain and swelling of the larger joints, with formation of serum, or pus; discharge from the nostrils; discharge from the ears, and permanent deafness; suppuration of the glands of the neck; troublesome ulcers of the tongue, pharynx, or epiglottis; croup; iritis and conjunctivitis; inflammatory affections of the internal viscera or of their serous coverings; abscess of the testis; mortification of the face, lower extremities, and pudenda; also of portions of the integuments on which the patient has lain; troublesome diarrhœa. Abscess of the brain is a remote result of cases of scarlatina that have been followed by pain and suppuration of the ear. The membrana tympani and small bones of the ear are destroyed, suppuration is set up in the cells of the petrous bone, followed by necrosis; and the neighboring veins may become implicated and lead to purulent deposits in the brain, indicated by intolerable pain in the corresponding part of the head, quickly followed by coma, preceded or not by convulsions.

Terminations.—In complete recovery. In recovery after one or more of the foregoing sequelæ. In imperfect recovery, the patient suffering from one of these sequelæ. In profound coma on the first appearance of the rash, followed by death in twenty-four hours, as if from the effects of a strong narcotic poison; in violent delirium during the first five days of the fever. In death, on the first, second, or third day, with incessant vomiting, or diarrhœa, or both. In death later in the disease from exhaustion, or as a consequence of any of the sequelæ.

Morbid Anatomy.—Death in the early stage usually occurs from failure of the heart's action, and the cause of this is found to be the formation of large fibrinous clots in the right side of the heart, and the large vessels connected with it, their ramification often extending to the brain and remote parts of the lungs. The other post-mortem appearances are those of the first stage of enteric fever—viz., inflammatory swelling of the agminate and solitary glands of the intestines, the mesenteric glands, and the spleen; and a deteriorated condition of the bile, the solid matter being reduced to $\frac{1}{3}$ or even $\frac{1}{10}$ of the normal amount, the biliary acids usually existing as a mere trace; in some cases there is a total absence of bile ("Med.-Chir. Trans," vol. lv., p. 121). Besides the above, we shall find ulceration and purulent collections in the tonsils, with inflammation extending from the fauces through the œsophagus, and sometimes through the whole alimentary canal. Congestion or inflammation of the kidneys. Inflammation and swelling of the joints. If the patient die from delirium and coma, great congestion of the vessels of the brain.

PATHOLOGY.—The disease is essentially an inflammatory affection of the lymphatic system; resulting no doubt in imperfect sanguification, and that deteriorated condition of the blood which leads to internal congestions and the separation of fibrinous clots.

CAUSES.—*Predisposing.*—Bad food and water. *Exciting.*—A specific poison (?).

MORTALITY.—The deaths in London in a million of the population vary from 350 to 2,130, and average 900. The fluctuations from year to year are considerable, and *the rate of mortality* in different years has varied in the following proportions: 1, 2, 3, 6, 10, 16, and 25 per cent.

LAWS OF INFECTION.—The disease is supposed to spread by contagion; it rarely attacks the same person more than once, but may occur a second and even a third time; and it may be communicated by inoculation of the contents of the vesicles which are sometimes blended with the rash; it is thought to be communicable before the appearance of the rash, and for as much as three weeks after its disappearance. It prevails constantly. In some cases, reported by Dr. Ballard, the disease was communicated by milk tainted by the hands of the milkers.

PERIOD OF INCUBATION.—From a few hours, or two or three days, to ten days or a fortnight. It is sometimes stated to be five days.

DIAGNOSIS.—Scarlatina may coexist with *Enteric fever* (see p. 282). *From measles* it is distinguished by the absence of cough, sneezing, and coryza; by the affection of the throat; by the peculiar appearance of the tongue; by the brighter hue, greater extent, and less defined form of the rash, which occurs in most cases on the second instead of the fourth day. The greater frequency of the pulse and the high temperature of the skin are also highly characteristic of scarlet fever, as are secondary dropsy, affections of the joints, and mortifications. From most cutaneous disorders by the extent of the eruption, the sore throat, and the fever. A supposed hybrid of scarlet fever and measles has been described under the term *Rötheln.* It is scarlatina *plus* cough, hoarseness, and lachrymation (symptoms of measles) due to the presence of the eruption on the mucous membranes. The rash on the skin is usually excessive in this form of the disease, and forms patches, and desquamation is usually very free.

Some cases of scarlatina which lapse into profound coma may be mistaken for narcotic poisoning, but the skin in such cases is usually as red as, or redder than, a boiled lobster.

For the distinction between scarlatina and diphtheria, see diphtheria.

PROGNOSIS.—*Favorable symptoms.*—The concomitant fever purely inflammatory, and the throat affection slight; abatement of the fever, and of the throat affection, on the appearance of the rash; epistaxis; diarrhœa; or other critical discharge. [In one case, I have known all the threatening symptoms to pass away, after a profuse discharge of mucus from the nostrils.] (G.) *Unfavorable symptoms.*—Early nausea and vomiting; the fauces dark red or purple, without swelling; ash-colored or brown specks,

quickly passing into ulceration or gangrene (*cynanche maligna*); brown tongue; great prostration of strength; early occurrence of delirium; coma; high fever after the occurrence of desquamation; dyspnœa, and stridulous voice, indicating the extension of the disease to the larynx and trachea; acute pain in the ear, with deafness and purulent discharge; acrid discharge from the nose; obstinate dryness of the skin; a fresh efflorescence and increase of fever; sudden disappearance of the rash. The pregnant, and especially the puerperal state, and teething.

A favorable convalescence may be expected when the pulse falls much below its natural frequency; and especially when the pulse at night is less frequent than in the morning. A frequent pulse, continuing when the urgent symptoms have subsided, is good ground for anticipating a lingering convalescence or secondary symptoms. (G.)

TREATMENT.—A moderate and equable temperature, about 60° Fahr.; a clean and spacious apartment; a light vegetable diet; cooling acidulated liquors for drink, and the saline draught as medicine; gentle aperients, especially toward the decline of the eruption. It is well to begin the treatment with an emetic (Form. 201), followed by a saline aperient, or full dose of castor-oil.

When there is much heat of body and dry skin, the patient should be immersed for ten minutes in a warm bath, and treated with saline diaphoretics.

When there is severe inflammation of the throat with external tenderness, and great difficulty in swallowing, from six to twelve leeches may be applied to the angle of the jaw, followed by a large hot poultice. In milder cases a linseed poultice, containing $\frac{1}{8}$ part of mustard, will suffice. Solution of nitrate of silver (gr. v. to ℨ i.) should be applied to the inflamed fauces twice a day. Astringent gargles (Form. 184) are very useful, and if the breath be offensive a little carbolic acid may be added. The following is a very useful form: Dissolve ℨ ii. of chlorate of potash in an ounce of water, add ℨ ss. of hydrochloric acid, and then water to ℥ vi. This gargle may be swallowed. As soon as the patient's strength begins to fail, 4 or 6 ozs. of wine should be given daily.

When the patient is convalescent, tonics, of which quinine is the best, and a nutritious diet with wine, in moderate quantity, should be prescribed. For a full fortnight after desquamation the patient should be kept warm in the house, unless the weather is exceptionally mild. A sudden chill arrests the action of the skin and leads to congestion of the kidneys. About the time when desquamation sets in, a little albumen is generally contained in the urine, and disappears after a day or two. If it persist and increase, we must resort to the hot bath, and keep the patient in bed. Scarlatina, which at any part of its course assumes the typhous character, is highly dangerous, and requires the employment of stimulants in full and repeated doses, as recommended in typhus fever. When the throat is covered with sloughs, the stimulating and disinfecting gargles, and strong solution of nitrate of silver, must be used at short intervals.

Prophylaxis.—The same precautions are required to prevent this disease from spreading as are recommended in typhus fever. (See p. 275; also "Nursing," p. 234.)

DIPHTHERITIS—DIPHTHERIA.

Definition.—A contagious and infectious disease, attended by inflammation of the commencement of the alimentary and respiratory passages, with fibrinous exudation.

Symptoms.—The disease is most insidious in its attack, and may be fully developed when the patient is still unconscious of any affection of the throat. But generally, there is a little stiffness of the neck, soreness of the throat, and slight difficulty of deglutition; and on inquiry, we learn that the patient has been feeling weak and a little out of sorts for two or three days. Sometimes there is considerable constitutional disorder, indicated by chills, nausea, and diarrhœa, with weakness, and loss of spirits. The state of the skin and pulse varies in different cases. On examining the back of the mouth, the isthmus of the fauces and tonsils is seen to be swollen and of a dark claret color, and in from twelve to forty-eight hours from the commencement of the throat affection, a smooth, tough layer of lymph, resembling wet felt or wash-leather, is formed over part of the inflamed surface. Sometimes the exudation appears first on the tonsil, whence it spreads to other parts; or the soft palate is the starting-point. But it may first show itself on the mucous membrane contiguous to these parts. Occasionally the exudation appears simultaneously at several points. From the points where it first appears it may spread down the œsophagus into the stomach, or, worse still, down the larynx, and along the trachea into the bronchial tubes. In about three days the whole inflamed surface is covered with a thick layer of lymph. If there be open ulcers on the skin, they are liable to be coated in a similar manner. The exudation is tough and fibrinous, rarely soft and pulpy; detached with some difficulty, and then exposing a smooth bleeding surface, on which the exudation re-forms in a few hours. The attack on the larynx is revealed by the voice, which is husky, or reduced to a whisper. The breathing may suddenly become croupy or stridulous, the face livid, the eyes prominent, the conjunctiva injected, and the supra-sternal and the supraclavicular depressions sucked inward in inspiration; and within a few hours the patient may die suffocated.

In proportion to the extent of the pharyngeal disease there is pain and difficulty in swallowing. In a later stage there is no pain. The parts have lost their sensibility.

The discharge from the nostrils consists of a thin muco-purulent matter like that which occurs in bad forms of scarlatina, so offensive that the whole atmosphere of the room is tainted by it; and the breath has the same putrid odor.

In such grave cases prostration rapidly comes on, and the patient lies on his back apathetic, or insensible and muttering. The heart's action, which had been feeble, though excited, now fails. The face is pallid, the pulse scarcely perceptible, and the patient dies of asthenia.

In many cases the urine is loaded with albumen.

The *duration of the disease* varies from forty-eight hours to fourteen days. Laryngeal symptoms usually show themselves early; and, if sudden, the patient dies within a week. In the absence of laryngeal symptoms, death from asthenia usually occurs during the second week.

Convalescence commences in the second week; but may be deferred to the beginning of the third.

SEQUELÆ.—These are of a very marked and important character. The most serious consists in great feebleness of the heart's action. When the patient is convalescent, and all things seem to be going on well, the heart may be losing force. Stimulants may be freely given, and yet the pulse becomes slower day by day, until it is reduced to half its normal number, and the patient, growing weaker and weaker, quietly expires.

Sometimes the whole muscular system is affected. The muscles become too weak to support the body or move the limbs; the patient cannot use his fingers to button his clothes or write a letter. This is not paralysis properly so-called, but is excessive depression of nerve force.

More frequently the debility affects only the muscles of deglutition and vocalization; the fauces appear to have lost their sensibility; solids can be swallowed, but fluids return through the nose. The voice is weak, hoarse, and nasal. In rarer cases the special senses are affected, and there is blindness or deafness on one or both sides. Disordered sensation, such as tingling in the hands or feet, occasionally occurs. Paralysis of sensation in restricted areas may occur.

These symptoms of disordered innervation may set in at any time, even up to six weeks after convalescence.

CAUSES.—*Predisposing.*—Debility. Childhood and youth; very rare in old persons. *Exciting.*—A poison, probably specific, generated within the body or external to it; and spreading by contagion and infection. It is epidemic at long intervals of time.

MORBID ANATOMY.—1. Fibrinous, or fibrino-cellular exudations covering the mucous membrane of the larynx, the upper portion or the whole of the trachea, and in some cases the bronchial tubes of their second or third ramifications. 2. The œsophagus and parts of the stomach reddened and inflamed, or covered with exudation. The inflamed mucous membrane and submucous tissue thick and hard; sometimes ulcerated; the soft palate and tonsils may be gangrenous. Abscesses in the cellular tissue surrounding the tonsils and pharynx. The cervical glands enlarged and hard, and the areola tissue infiltrated with serum. 3. In death from asthenia, large fibrinous coagula in the heart or great vessels.

DIAGNOSIS.—From *Quinsy* by not being limited to the tonsils, and by the fibrinous exudation. In *common sore throat* there is no exudation,

but a tendency to ulceration. *Croup* is the laryngeal part of the disease. Malignant *scarlatina* and diphtheria have so many resemblances, and so few differences, that satisfactory evidence of their being distinct diseases is wanting. The strongest argument in favor of their being distinct, is the fact that the one affords no protection against the other.

Prognosis.—Must be cautious and guarded, especially in the early stage. If, at the end of a week, there are no laryngeal symptoms, our prognosis may be favorable. A robust patient will be less liable to secondary nervous affections than one of weakly habit.

Treatment.—*Constitutional.*—A sustaining and stimulant plan will have to be adopted from the first. If the pulse be feeble, ammonia and bark should be given every four hours, and half a pint of wine or brandy-and-water, beaten up with egg, may be given every day; milk or beef-tea being administered in the intervals.

If the skin be hot, we should give diaphoretics; if cool and clammy, ♏ xx.–xxx. of tincture of perchloride of iron in a wineglassful of water, or a moderate dose of quinine and acid, may be given thrice a day. Daily action of the bowels should be induced by saline aperients (Forms. 242 and 244).

Local.—Hot bread-and-mustard poultices to the throat. The application by a small sponge or camel-hair brush of a strong solution (gr. xl. to ℥ i.) of nitrate of silver to the inflamed fauces night and morning; or solid nitrate of silver may be passed lightly over the parts. The acid chlorine gargle (Form. 63), or perchloride of iron (ʒ vi. of the tincture to ℥ viii. of water), may be used if the act of gargling does not distress the patient. Laryngeal symptoms are much relieved by inhalations of hot water, or of a mixture of vinegar and water. A leech may be placed at once over either side of the cricoid cartilage. If the exudation seems loosely attached to the mucous membrane of the larynx, we may give an emetic of sulphate of zinc. If suffocation be imminent, we must resort to tracheotomy: it may prolong life in many cases, and save it in a few. If the exudation affect the lower part of the trachea, the operation will act only as a palliative.

Depression of vital power must be combated on the broad principle that stimulants are tonics to the weak.

PESTIS—PLAGUE.

Definition.—A contagious fever, intermittent, remittent or continued, accompanied by buboes, carbuncles, and petechiæ.

Symptoms.—The patient is attacked suddenly, or after slight premonitory rigors, with lassitude, depression and restlessness, dull pain of head, and giddiness, with an indescribable feeling of anxiety, and pain in the region of the heart. The eye is dull and sleepy, the eyelids closed, the mouth half open; and the gait staggering and uncertain, like that of a drunken man. There is nausea, or bilious vomiting, often accompanied

by diarrhœa; the urine is scanty, high-colored, and sometimes bloody; the tongue is swollen, furred, and glistening, but moist and clean toward the tip and edges; pulse from 115 to 130, and very feeble; respiration hurried; speech indistinct and faltering. After twelve hours, there is usually some reaction, with insomnia and delirium; the eye is bright, and the pupil dilated. The pulse is hard and full, or weak, fluttering, and intermittent; the tongue dry, red in the centre and at the edges, brown and cracked; the lips, teeth, and nostrils are coated with dry sordes; there is intense thirst, and constant nausea, with occasional vomiting of a black fluid; the evacuations from the bowels are dark and offensive, mixed with grumous blood; and sometimes there is hemorrhage, perhaps from the nose. On the second or third day, sometimes much later and sometimes as early as the first day, the characteristic external marks of the disease begin to show themselves. Darting pains in the axillæ, groins, or neck, direct attention to the glandular swellings and carbuncles, which, in favorable cases, are bright red; in dangerous ones, livid or purple.

The crisis is by profuse perspiration and suppuration of the tumors, the patient beginning to improve from the sixth or eighth to the fourteenth or twentieth day. In unfavorable cases, the skin remains harsh and dry; the pulse small and fluttering; low muttering delirium and laborious breathing set in; the eye is sunk, the countenance ghastly; the skin covered with petechiæ and vibices; while the buboes remain stationary. At length the patient becomes comatose, and death takes place, commonly on the fourth or fifth day, without a struggle.

In the mildest cases the patient goes about his usual avocations, though suffering from the swollen glands. In the worst cases, the patient does not rally from the first shock to the nervous system, but sinks within twenty-four hours, or as late as the second or third day, with buboes.

The plague may be said to assume four degrees of severity: 1. Slight fever, without delirium or buboes. 2. Fever, delirium, and buboes. 3. Fever, delirium or coma, buboes, carbuncles, and petechiæ. 4. Congestive fever, fatal on the first, second, or third day, without buboes. The fever may be intermittent, remittent, or continued; the last-named form being most common.

Causes.—*Predisposing.*—Poverty, filth, overcrowding, debility, disease, intemperance, adult age. *Exciting.*—Probably the same as enteric fever.

Laws of Infection.—Period of incubation, from a few hours to about twenty days. The disease is endemic in Egypt, often spreads to surrounding countries, and formerly prevailed in almost every part of Europe. An analogous disease is believed to exist in some parts of India. In common with other epidemics, plague attacks few persons at first, gradually attains its maximum intensity, and subsides as gradually. The rate of mortality is also greatest at the commencement of the epidemic, and at its first outbreak in each district.

Mortality.—At first, nine-tenths of the cases, or more; in the decline, a small proportion only. Throughout an epidemic, from one-third to two-

thirds, or even four-fifths, of those attacked. In large cities, a third, or nearly a half of the population is believed to have perished. In Smyrna, during five months of 1834, out of 5,727 persons attacked, 4,831, or 84 per cent., died; 1 in 23 of the whole population suffered, and the deaths were about 1 in 27.

Prognosis.—Highly unfavorable, especially at the outbreak of the disease; guarded even in mild cases. *Favorable symptoms.*—The early formation of firm and movable buboes passing rapidly into suppuration; profuse perspiration; an absence of severe fever; life prolonged beyond eight days. *Unfavorable.*—Subsidence of the buboes; suppression of urine; hæmaturia; petechiæ; obstinate vomiting; and all the symptoms which would be deemed unfavorable in continued fever. The puerperal state.

Treatment.—That of typhus fever, with warm poultices to the buboes and carbuncles, to promote suppuration, followed by prompt incisions. Mercury has been recommended, and most of the cases in which salivation has taken place have recovered; but it is doubtful whether these have not been cases that would have got well under any treatment. The disease appears to be almost equally fatal under all modes of treatment.

Prophylaxis.—Separation from the sick and an unusually strict observance of all the laws of health. The avoidance of impure food and water. In the case of ships from infected places, a quarantine of twenty-one days; and if there are cases of plague on board, twenty-one days from the recovery of the last case.[1]

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[1] For a condensed account of the Plague as Hodges saw it in London in 1665, consult Dr. Guy's "Public Health," Lecture IV., and the Black Death, in Lecture II. Also Howard on "Lazarettos," and Sir James McGregor's "Medical Sketches of the Expedition to Egypt from India." For the state of the places in which the plague is bred and nursed, see Sir Robert Wilson's "Expedition to Egypt," especially note at p. 116.

CHAPTER V.

FEVERS—*Continued.*

Febris Hectica, . . .	Hectic Fever.
Febris Infantum Remittens, .	Infantile Remittent Fever.
Pyæmia, ...	Pyogenic Fever.
Febres Puerperales, . .	Puerperal Fevers.
Cellulitis Venenata, . .	Dissection-wounds.
Farcinoma, ...	Glanders.
Pustula Maligna, . . .	Malignant Pustule.

FEBRIS HECTICA—HECTIC FEVER.

Definition.—A remittent fever, caused by local irritation in a weakened constitution.

Symptoms.—Chills, succeeded by flushes, terminating in a hot skin and frequent pulse, and these by perspiration, constitute the paroxysm of hectic fever ; of which there are commonly two in the twenty-four hours. The first generally occurs about noon, and lasts about four or five hours. After a short interval of freedom, a more severe paroxysm occurs, which increases in violence till about two o'clock in the morning, when a perspiration, at first partial and then general, breaks out and carries off the fever.

The pulse during the paroxysms is quick and frequent, ranging from 96 to 130, or more ; the temperature 102° to 105° Fahr., or more ; the urine is high-colored, and deposits a pink sediment ; the cheeks wear a circumscribed crimson blush—the hectic flush—and there is a burning heat in the palms of the hands and soles of the feet. During the remission, the pulse and temperature fall, but seldom to the level of health. There is little loss of appetite, and the tongue is clean, moist, and red. The patient rapidly loses flesh.

At length the paroxysms become more violent and the remissions shorter ; the appetite fails ; colliquative sweats alternate with diarrhœa ; and under an increased severity of these symptoms, and of the disease which causes them, the patient sinks.

Diagnosis.—From idiopathic remittent fever by the pre-existence of local disease.

Prognosis.—Favorable or unfavorable according to the nature of the local disease, of which the fever is the effect and symptom.

Causes.—Generally the formation of pus, as in suppuration of the lungs, liver, hip-joint, etc. But any local irritation in a weakened constitution, without suppuration, may occasion it. The infantile fever, caused by intestinal irritation, is but a form of hectic. It is in advanced stages of consumption and in extensive suppuration of joints that hectic fever is developed in its most characteristic form.

Treatment.—That of the disease of which the fever is symptomatic. When the local cause is obscure, the treatment must be that of debility, and quinine will be the appropriate remedy.

FEBRIS INFANTUM REMITTENS—INFANTILE REMITTENT FEVER.

Synonyms.—Infantile gastric remittent—infantile hectic. Worm, or mesenteric, stomach fever. Low fever of children. Marasmus.

Definition.—A fever due to gastro-intestinal irritation, from worms, retention of fæces, or other functional disorder of the digestive organs.

Symptoms.—Pallor, languor, drowsiness, and chilliness in the morning; flushed cheek, hot skin, restlessness and feverishness toward evening, followed at night by profuse sweating, and toward morning by a distinct remission. Skin dry; tongue moist, but coated; breath tainted, pulse frequent; appetite variable and capricious or absent; urine scanty; bowels costive or relaxed, or both alternately; the evacuations slimy and sour smelling, dark green, deep yellow, pitchy, or clay-colored, and very offensive; the abdomen tumid and often hot to the touch. The child constantly picks the nose and lips, and rubs the corners of the eyes, and the anus.

In milder cases, the remittent character of the fever is less strongly marked; the chilliness and languor of the morning, and the febrile exacerbation of the evening being very indistinct; but the child looks pale and listless, and loses appetite. After a time symptoms of phthisis, tabes mesenterica, hydrocephalus, or enteric fever, show themselves with rapid loss of flesh, till at last the plump and rosy features of the child are changed to the meagre aspect of shrivelled old age. The more the child wastes, the more restless and irritable does it become till the last stage of debility arrives, when he dies from exhaustion, in a state of total unconsciousness, or with the mental faculties unimpaired to the last.

Morbid Appearances.—Inflammation and ulceration of the small intestines. Enlargement, induration, or suppuration of the mesenteric glands. Inflammation of the lungs. Congestion and inflammation of the brain with serous effusion.

Diagnosis.—Rose-colored spots, a fissured tongue, loose ochre-colored stools, or hemorrhage, declare the presence of *enteric fever*. Coma, strabismus, and convulsions; distention of the veins of the scalp, prominence of the fontanelle, and heat of head, indicate *hydrocephalus* or *tubercular meningitis*. An enlarged and tense abdomen declares *tubercular*

peritonitis or *tabes mesenterica.* Cough and hurried respiration and diarrhœa excite suspicion of *pulmonary and abdominal phthisis.*

Prognosis.—*Favorable* when due to worms, constipation, or other simple derangement of the alimentary canal. *Unfavorable.*—When complicated with the diseases specified above.

Causes.—*Predisposing.*—Bad air, want of exercise, improper or deficient food, dentition. *Exciting.*—Irritation of the mucous membrane of the intestinal canal by worms, constipation, diarrhœa, or improper diet.

Treatment.—This consists in restoring the tone and natural action of the stomach and bowels by proper aperients and a restricted diet.

As long as vomiting or diarrhœa is present, milk, milk-gruel, arrowroot, or broth, without any form of solid food, should be prescribed. In the absence of diarrhœa, rice-milk, bread-and-milk, puddings of rice, cornflour, and bread. In infants a still stricter diet is often necessary. The stomach is often very irritable, and rejects even the simplest farinaceous food. In such cases a tablespoonful of new milk from the cow should be given every half-hour or hour, combined, if acidity be present, with a little lime-water or carbonate of soda. This treatment is very effectual. The stomach wants rest ; and the patient wastes, because it is not allowed to rest ; it rejects food in ordinary quantity, and will bear none in any quantity but that which is natural to it at that early age.

In this disease, as in enteric fever, it is of the first importance to watch narrowly the state of the alvine secretions, both before and after the administration of medicines. *Scybala, mucous discharges,* and *worms* indicate the necessity of aperients, of which there is none better than castor-oil, aided, if necessary, by enemata of warm water.

If the motions are pale-colored, a cholagogue aperient or mercurial alterative (Form. 257) should be given every, or every other, night, followed by an occasional dose of castor-oil in the morning. If worms are present, an anthelmintic (Form. 258) should be given.

Diarrhœa will generally yield in a short time to a diet of milk-gruel, without any kind of solid food, and then the aperient treatment should be resumed. As the health improves, the diet may become less strict. It is a grave error in this disease to prescribe the more solid forms of nourishing food.

PYÆMIA.

Synonyms.—Simple pyogenic fever (Jenner). Septicæmia (Vogel). Ichoræmia (Virchow). Purulent diathesis (Tessier). Suppurative phlebitis.

Definition.—Severe pyrexia, the result of an admixture of pus or sanies with the blood.

Symptoms.—These supervene on parturition ; acute abscesses ; wounds ; injuries to bones ; the infectious fevers, etc.; and begin with severe rigors,

followed by intense fever ; pulse 100 to 140, full and hard ; tongue dry and brown ; severe muscular and articular pains ; more or less delirium. If the foot have been the seat of operation or injury, deep-seated pain, followed by swelling or tenderness in the muscles of the calf, in the ankle, knee, or hip-joints, or in all these parts in succession. There is usually more or less swelling and tenderness in the course of the main veins of the limb, and deep-seated fluctuations may be detected in the neighboring muscles of the leg and thigh. The fever may now subside, leaving the patient very weak ; or, as is more usual, with hectic flushes in the typhous condition, ending in death by coma. If the purulent infection spread from the head, severe meningitis, encephalitis, and pleuro-pneumonia generally appear at an early stage ; if from the upper extremity, there are pain and swelling of the muscles of the shoulder and of the fore or upper arm, of the elbow, and sterno-clavicular joints, accompanied by phlegmonous inflammation of the corresponding parts of the integument, and followed by deep-seated fluctuation.

Sometimes the disease is general, and all the large joints of the body become painful, tense, and fluctuating, at the same time that the lungs are partially consolidated by inflammatory exudation. But the disease may be limited to a hand or foot, where successive abscesses make their appearance.

Pathology.—If the exciting cause be in the leg, diffuse abscesses form in the muscular cellular tissue, or in the muscles themselves. The areolar tissue round the coats of the main veins leading from the seat of injury becomes hard and swollen, and the coats of the veins themselves thickened (phlebitis). The affected veins are obstructed with dark, firm coagula, or filled with pus. The following is an example: A patient had a bit of necrosed bone removed from the fifth metatarsal bone of the left foot, and two days afterward symptoms of pyæmia appeared. He died on the twenty-first day ; meanwhile the little wound made by the operation healed completely ; the left iliac vein, and the left femoral vein, down to the ham, were filled with creamy pus, and the mouths of their tributaries were plugged with dark, clotted blood ; the muscles of the calf were imbedded in a diffuse abscess.

If the intestines be the seat of lesion, inflammation, and numerous minute abscesses may be found in the liver. If the disease have sprung from necrosis of the bones of the internal ear, or from injury to the bones of the skull, the veins of the diplöe are filled with pus ; pus and other products of inflammation will be effused between the dura mater and the bone, between or beneath the membranes, or in the substance of the brain itself, and very commonly in the lungs. Purulent effusions are often found in the pleural and peritoneal sacs.

Causes.—1. The formation of pus in the blood-vessels themselves. 2. The absorption of pus or sanies from any suppurating surface. And as ulcers sometimes form on the inner surface of the heart and arteries, it follows that pus may be directly discharged from them into the blood.

As to the absorption of pus—this may take place directly, from the inflamed inner surface of the divided vein, the open extremity of which communicates with the suppurating surface, or, by the capillary action of its empty portion.

Diagnosis.—White blood-cells and pus-corpuscles resemble each other so closely that when white cells are found in unusual quantity in the blood, our only means of diagnosis are the conditions anterior to their formation. If the patient died of anæmia, with or without disease of the spleen or lymphatic glands, we attribute the white cells to leucæmia ; if pyogenic fever have been present, to pyæmia.

Prognosis.—Very *unfavorable* when the disease comes on after amputation, childbirth, or infectious fever ; *favorable* in proportion as the fever subsides, the internal organs escape, and the disease is limited to the limbs, or the muscles and integuments of the trunk.

Treatment.—*General.*—That recommended for the last stage of typhus fever ; we promote sleep and alleviate pain by full doses of opium. Quinine with acid may be given in large doses in the early stage. *Local.*—Leeches and cold affusions to the head if necessary ; hot fomentations and poultices to inflamed places ; free incisions wherever fluctuation can be detected.

FEBRES PUERPERALES—PUERPERAL FEVERS.

Under this title several forms of disease have been described, differing in many respects, but all of them combining a well-marked febrile affection with a local disease varying in seat, character, and intensity. The following distinct forms are recognized :

1. Acute Puerperal Peritonitis.
2. Adynamic, or Malignant Puerperal Fever.
3. Puerperal Intestinal Irritation.
4. False Puerperal Peritonitis.
5. Milk Fever.

General Remarks on Puerperal Fever.

The diseases usually characterized as Puerperal Fever are the first two of this group—*acute puerperal peritonitis* and *adynamic* or *malignant puerperal fever*. Both these have been observed in different epidemics ; and cases of both forms in the same epidemic. These two forms, and all their varieties, have their origin in the same cause, *uterine phlebitis*, the result probably of the passage of sanious or purulent fluid from the uterine cavity into the uterine circulation. If the uterus remain large and tender, and the discharges offensive, we may apprehend the accession of puerperal fever in some form or other. The local lesions of puerperal fever involve one or all of

the organs of gestation. The disease commonly spreads from the peritoneal covering of the uterus. But its muscular walls may be the seat of abscess, softening, and gangrene, or the lining membrane may be softened and gangrenous, and the open mouths of the veins exude putrid sanies. The veins and lymphatics are inflamed, and either blocked up with clots or distended with pus. Diffuse pelvic cellulitis, resulting in large purulent collections, is not uncommon, and inflammation and suppuration of the ovaries are among the local lesions. Purulent deposits in the muscles, joints, and phlegmasia dolens, arise as secondary affections.

There is no doubt that some local lesion, not always very severe, will be found on careful examination in every case of fatal puerperal fever, and to this it is reasonable to attribute the fever. But some observers hold that there is a specific poison which generates the fever, and that the local lesions are its secondary results. Puerperal fever is indeed highly contagious, aud repeated experience has proved that a practitioner may, after the strictest precautions, carry the disease from patient to patient in uninterrupted succession. The experience of lying-in hospitals is also corroborative of its highly contagious, if not infectious nature. We should, therefore, conclude that there is a *specific* poison had it not been observed that the common post-mortem poison and erysipelas will also give rise to puerperal fever. The true explanation appears to be this: that just as diastase will bring about an immediate conversion of starch into sugar, so will a certain condition of the animal fluids induce a suppurative change in the tissues. This theory will not only account for the production of puerperal fever, but will serve to indicate the precautions medical practitioners should use in attending parturient women. They must avoid contact with erysipelas, post-mortem fluids, and all putrid discharges; but if they have come into contact with them, the hands should be well washed in a running stream, and several times soaked in a solution of carbolic acid.

1. Acute Puerperal Peritonitis.

Symptoms.—Severe rigor, commencing from the second to the fourth day after delivery, and in some cases much later; followed by acute pain in the abdomen, and generally in the hypogastric region; the uterus is enlarged, and very tender. The pain is constant, augmented at intervals, increased by pressure and motion, and accompanied by fulness and tension of the belly. The secretion of milk is checked, and the lochial discharge is either suppressed, or, if it continue, is very offensive; the skin is hot; the pulse either frequent, small, and wiry, or full and bounding; the tongue furred. There is headache, restlessness, and sleeplessness, with pinched, anxious, and suffused countenance, occasional vomiting, and hurried breathing. In unfavorable cases, the pain and tension of the abdomen increase, the pulse becomes more and more rapid, the skin cold and clammy, the head first feels confused, and then muttering delirium

follows; the tongue becomes dry and brown, the teeth covered with sordes; distressing eructation and vomiting, hiccough, subsultus tendinum, pinched features and cold extremities, usher in the fatal result.

Morbid Appearances.—Redness of the peritoneum, especially of that covering the uterus, and its appendages, with effusion of solid lymph and serum into its cavity. The uterus, ovaries, and Fallopian tubes covered with creamy matter. Purulent deposits sometimes found in the muscular structure of the uterus, and the ovaries often the seat of abscess.

Causes.—*Contagion.*—The common causes of inflammation. It is often epidemic, and coexists with or precedes the malignant variety.

Prognosis.—*Favorable*, but guarded, if the treatment be commenced early, and if the reigning epidemic be of a mild character.

Treatment.—*General.*—Leeches to the abdomen in number according to the severity of the symptoms and strength of the patient; hot fomentations; calomel in doses of half a grain, combined with half a grain of opium, or five grains of Dover's powder, every two, three, or four hours, continued till salivation shows itself. Cooling drinks and cool air. Nourishing food and stimulants, as wine, brandy, and ammonia, or turpentine, taken by the mouth, and injected into the bowel.

Local.—The uterus should be thoroughly and frequently washed out with warm water containing $\frac{1}{20}$ part of an aqueous solution of carbolic acid. A purgative of castor-oil, or salts and senna, to be administered at the outset, and if swelling, tension, and tenderness continue, hot fomentations or turpentine stupes should be constantly applied to the abdomen.

2. Adynamic, or Malignant Puerperal Fever.

Synonym.—Puerperal hysteritis or metritis.

Symptoms.—More obscure than the foregoing: the rigor less strongly marked, the pain in the abdomen less severe, little increased by pressure, deep-seated, more circumscribed, and often limited to the hypogastric or iliac regions. The pulse, from the first, extremely small, rapid, and weak, ranging from 130 to 160; countenance anxious; skin sallow; extreme restlessness; intellect, though sometimes clear to the last, generally wandering; low, muttering delirium; tongue at first white, then dirty yellow, then dry and brown; if blood be taken, it is dark-colored and the coagulum very loose; eructation, vomiting, hiccough, diarrhœa; the evacuations highly offensive; lochial discharges fetid or suppressed; breasts flaccid; abdomen tumid and tympanitic; uterus large, uncontracted, tender. Death after the usual typhous symptoms, or slow recovery.

Morbid Appearances.—Peritoneum of a dusky hue; effused fluid dirty brown, often bloody and mixed with lymph. Fetid gas in the intestines. Uterus softened, or gangrenous; ovaries reduced to a pulp. Pus in the veins of the uterus, and in the joints; inflammation, and abscess of the cellular membrane of the leg, etc. In a word, pyæmia.

Causes.—Uterine phlebitis. Contagion.

PROGNOSIS.—*Unfavorable* in all cases.

TREATMENT.—The general and local treatment as in the peritoneal form.

As the source of the mischief lies in the uterus, its condition should be narrowly watched for the first few days after delivery, and if it remain large and tender, and the discharges become offensive, no time should be lost in washing out the disorganized clots and fetid discharges with warm disinfecting fluids, and this operation should be repeated from time to time. Clysters of warm water may also be used.

3. PUERPERAL INTESTINAL IRRITATION.

SYMPTOMS.—General uneasiness, coming on at any period after delivery, if the bowels have been neglected; loss of appetite; tongue furred; chills alternating with flushes; headache; frequent pulse; abdomen large and rather tense; slight, deep-seated pain, relieved by steady pressure; nausea and vomiting of a dark offensive fluid; diarrhœa; evacuations dark, fetid, watery, or slimy; flatulence; fœtor of breath. In unfavorable cases extreme debility and despondency; the red tongue of acute gastric irritation; often aphthæ of the tongue and mouth. The diarrhœa continuing and the strength diminishing, the fever increases and assumes the typhous form.

MORBID APPEARANCES.—Generally none. Sometimes inflammation, with or without ulceration, of the mucous membrane of the intestines.

PROGNOSIS.—More favorable than either of the preceding varieties.

TREATMENT.—At first a full dose of calomel and opium followed by castor-oil, to relieve the intestines of retained or offensive matters. If need be the calomel and opium may be repeated, or a dose of castor-oil in place of it. The local and dietary treatment should be that of enteric fever. Diarrhœa to be treated by the chalk and opium powder.

4. PUERPERAL PERITONEAL IRRITATION.

SYMPTOMS.—After a slight rigor, pain and tenderness of the abdomen, a slightly coated tongue, a rapid and very compressible pulse; with some heat of skin. It occurs chiefly in delicate and nervous females, after unusually severe after-pains, or from the violent operation of a purgative. Profuse perspiration and diarrhœa are present in some cases.

PROGNOSIS.—*Favorable.*

DIAGNOSIS.—From true puerperal peritonitis by the milder character of the symptoms.

TREATMENT.—Fomentations, poultices, diaphoretics, and opiates, with an occasional mild laxative. Ten grains of Dover's powder, or from 15 drops of laudanum, may be given at once, and repeated if necessary.

5. Milk Fever.

Symptoms.—About the third day after delivery a well-marked rigor, followed by a hot and then a sweating stage; great pain and throbbing in the head; intolerance of light and sound; flushed countenance; blood-shot eye; contracted pupils; pulse frequent, full, and hard; skin hot and dry; thirst excessive; tongue dry and coated; breasts hot, tense, and painful. If speedy relief be not obtained, the head symptoms become more severe, attended perhaps by slight delirium; the breasts are hard and painful, and suckling cannot be borne; and, after a time, local inflammation with an increase of fever sets in, followed by abscess of the breasts.

Causes.—Accumulation and retention of the lacteal secretion.

Diagnosis.—From other puerperal fevers by the local affection.

Treatment.—The free use of saline aperients. The breasts to be kept cool by an evaporating lotion, or gently rubbed with sweet oil or belladonna liniment. The infant or a breast-pump should be applied to the nipples as soon as it can be borne. If the congestion of the breasts continue, we apply a few leeches followed by warm poultices or fomentations.

CELLULITIS VENENATA—DISSECTION WOUNDS.

Definition.—Inflammation of the cellular tissue, with severe febrile symptoms, caused by a poison contained in certain dead bodies, and absorbed from wounds.

The wound may be received in dissecting, or may exist previously, but in some cases there has been no wound or injury of any kind.

Symptoms.—In most cases the disease sets in, within a few hours of the accident, with inflammation at the seat of the puncture; but in rare instances the local affection is preceded by febrile symptoms, ushered in by severe rigors. The inflammation commencing in the puncture first affects the hand, then gradually extends up the arm till it reaches the axilla, whence it sometimes extends to the trunk, and even to the lower extremity. It is accompanied by swelling, tension, and throbbing pain in the parts affected; the course of the absorbent vessels is often indicated by dusky red lines, or by an erythematous blush, with irregularly defined outline, and the lymphatic glands above the elbow and in the axilla are swollen and painful. The inflamed parts are at first exquisitely tender, but become less sensitive as the disease advances. In favorable cases the inflammation terminates in serous effusion, which is gradually absorbed. In more severe cases suppuration of the cellular tissue, both superficial and deep-seated, occurs, and abscesses form under the theca of the punctured finger, or diffused abscess attacks the cellular membrane on the hand and arm, or even on the trunk. When the inflammation runs very high, it sometimes terminates in extensive sloughs. In some of the least favorable cases the local affection is very slight. The punctured part be-

comes the seat of a small vesicle or pustule, and the inflammation at once attacks the axillary glands ; the neck and upper part of the chest are swollen, stiff, and painful, and the inflammation sometimes extends over the trunk and lower extremities. Occasionally deep-seated diffuse abscesses form without any superficial inflammation. The febrile symptoms often assume the typhous character, with profuse fetid sweats, great debility, extreme depression, and high nervous excitement. The mind is generally unaffected ; but the patient sleeps little, and is sometimes delirious at night. Recovery is often slow and imperfect, the hand remaining stiff from the slow absorption of effused fluids, the thickening of the textures, or the injury attending on suppuration or gangrene. Health returns but slowly.

Cause.—A contagious matter absorbed from a sore or wound on the hand, rarely through the unbroken skin, from animal matter in the first stage of decomposition.

Diagnosis.—Difficult in those cases in which no wound or sore can be discovered. The acute sensibility of the inflamed parts is very characteristic.

Prognosis.—The mortality in severe cases is about 50 per cent. *Favorable symptoms.*—Inflammation limited to the cellular tissue, and, at the worst, axillary abscess. *Unfavorable.*—Extension of the inflammation beyond the axilla, and general pyæmia.

Treatment.—When local inflammation runs high, leeches may be applied to the inflamed part, followed by warm fomentations. When suppuration is taking place, warm poultices or fomentations should be kept constantly applied. Pus when formed to be discharged by free and deep incisions.

The patient's strength will have to be supported by stimulants, such as ammonia and ether, with wine and a nourishing diet.

When there is acute pain and great excitement, full doses of opium or of its preparations, are to be given ; with ammonia or ether when the symptoms assume the typhous character.

Prophylaxis.—Wounds received in dissection, especially of bodies recently dead, should be immediately washed, and the wounded finger or part strongly sucked for some time. On the appearance of the least inflammation the part should be poulticed. Caustic to do good must be applied at once to the bottom of the puncture.

FARCINOMA—GLANDERS.—FARCY.

Synonym.—Equinia.

Definition.—A contagious malady, characterized by inflammation of the nasal mucous membrane, and by inflammatory tumors and pustules in different parts of the body, caused by contact with the horse or other quadruped, or with persons suffering from the disease.

Varieties.—1. Acute glanders. 2. Chronic glanders.

1. Acute Glanders.

Symptoms.—The disease generally sets in with pain in the head, back, and limbs, rigors, nausea, thirst, great prostration of strength, with stiffness and pain in the joints, increased by motion. These symptoms are followed, after a short but variable interval, by tumors, red, painful, and tender, in different parts of the body, terminating in abscesses discharging a fetid sanies, and passing quickly into gangrene. From the fourth to the sixteenth day a profuse discharge of a yellow or sanious fluid from the nostrils sets in, accompanied by redness, heat, swelling, and excoriation of the nose, lips, and cheeks; the eyes are inflamed, and the eyelids swollen. Pustules and black bullæ appear on the face, trunk, limbs, and parts of generation. These local symptoms are accompanied by a hot skin, urgent thirst, frequent, weak, and irregular pulse, and feeble respiration. The tongue is covered with a dark fur; the skin is bathed in a profuse and offensive perspiration; the evacuations are slimy and fetid. These symptoms increase in severity, and are followed, after a few days, by diffused abscesses in different parts of the body, especially about the joints; typhous symptoms rapidly supervene; the nose and lips become gangrenous; the discharges extremely offensive; low muttering delirium sets in, and death takes place by collapse. The greater number of patients die within a fortnight; few survive till the third or fourth week. One death is reported at the end of more than two months.

Anatomical Characters.—Besides the superficial pustules and tumors, congestion of the mucous membrane of the nose, fauces, air-passages, and alimentary canal; congestion of the lungs; phlebitis; purulent deposits in the lungs and joints; diffused abscess in the cellular membrane; and bloody fluid in the serous cavities.

Causes.—Contagion and infection. The disease originates in quadrupeds from overwork, privation, or overcrowding, and is most commonly communicated from the horse to the human subject.

Diagnosis.—The peculiar discharge from the nostrils, the seat and character of the pustules, the history of the case, and the occupation of the patient are quite characteristic. Farcy is distinguished from glanders by the absence of the peculiar discharge from the nostrils. But the two terms, Glanders and Farcy, are not used with much discrimination, at least in respect of the human subject. Farcy, in the horse, is distinguished as *button-farcy,* and *bud-farcy,* according as the tumors attack the cellular tissue and lymphatic glands, or the lymphatic glands only.

Prognosis.—Acute glanders is generally and speedily fatal. In chronic glanders the prognosis is more favorable; in farcy still more so.

Treatment.—No specific has yet been discovered. General treatment that of typhus fever: local treatment as in dissection wounds.

Prophylaxis.—Grooms in charge of glandered horses should wear gloves, avoid contact with the animals, and practise scrupulous cleanliness. Wounds or sores should be promptly treated by suction. Stables in which

glandered horses have been kept should be thoroughly cleaned and fumigated, scraped and whitewashed, and harness and horsecloths either destroyed or exposed to a high temperature, and thoroughly washed, carbolic acid being freely used.

2. Chronic Glanders.—In this form, the local symptoms precede the fever, and they resemble the effects of a dissection wound. After a few hours from the inoculation, inflammation attacks the lymphatics, and extends along the arm to the axilla, and even to the parotid and submaxillary glands. Extensive abscesses form in the cellular tissue of the limb, and, in fatal cases, a pustular rash, accompanied by dark bullæ, appears on the skin, followed by well-marked hectic fever. The duration of the fever is often very considerable, both in favorable and in fatal cases.

The term chronic glanders is used as synonymous with acute farcy; chronic farcy being a still milder and more protracted disease.

PUSTULA MALIGNA—MALIGNANT PUSTULE.

Synonyms.—Charbon. Sang-de-rate. Wool-sorters' disease.

Symptoms.—A deep-red spot like a gnat's bite, or a dusky pimple ("*grano negro*") soon surmounted by a vesicle of reddish serum. There is enough irritation and itching to lead to speedy rupture of the vesicle, and after a few hours the site is occupied by a dark depression around which a ring of fresh vesicles forms. The central part now rapidly passes into a dry, hard, gangrenous eschar including the whole of the skin. This continues enlarging, and fresh vesicles form around its margin; the part is slightly raised and forms a hard, roundish dusky tumor bounded by a livid areola. The disease spreads and rapidly involves large patches of integument. At first there is burning heat, but at no time much pain. As soon as the part begins to swell the constitutional symptoms described at p. 269 show themselves, and the patient dies before the eighth day, unless the mortification be arrested, in which case the subsequent progress is that of severe anthrax. A low form of pleuro-pneumonia, or of enteritis, is a frequent concomitant.

Cause.—Contact with the bodies or carcasses of beasts affected with "*Charbon*" or "*sang-de-rate.*" According to some observers, the development of bacilli in the blood, constitutes the essence of the disease. Dr. Bell, of Bradford, has called attention to the prevalence of the disease amongst persons engaged in working an inferior kind of mohair. Flies and gnats are said to convey the disease. It is not uncommon among the herds and flocks of the mountainous pastures of Europe and North America.

Treatment.—That of blood-poisoning (p. 315).

CHAPTER VI.

GENERAL DISEASES (NON-FEBRILE).

Scrofula,	King's Evil.
Rachitis,	Rickets.
Mollities Ossium,	Softening of the bones.
Purpura,	Scurvy.
Rheumatismus,	Rheumatism.
Podagra,	Gout.

SCROFULA OR STRUMA—KING'S EVIL.

Definition.—The deposit of *tubercle* in several organs of the body, with a tendency to indolent inflammatory swellings and chronic ulcers.

The most common forms of scrofulous disease are, chronic inflammation and suppuration of the glands of the neck, strumous ophthalmia, and chronic ulcers of the cornea, indolent abscesses of the skin, enlarged tonsils, mollities ossium, diseases of the bones and joints, psoas abscess, tabes mesenterica, and pulmonary consumption. The scrofulous, too, are more subject than others to hysteria and to mental disorders.

The form of scrofula to be here described is that which attacks the absorbent glands of the neck. Other scrofulous affections will be considered under Rachitis, Tabes Mesenterica, Phthisis Pulmonalis, and Strumous Ophthalmia.

Symptoms.—The scrofulous constitution is indicated by a lax habit of body, a thin fair skin, delicate rosy complexion, fair and fine hair, full upper lip, and tumid septum and alæ nasi. We recognize the same constitution in spare, pale children, with projecting foreheads, misshapen heads, narrow and deformed chests, swollen fingers, enlarged joints, irregular and unsound teeth, tumid abdomens, cold extremities, and great liability to chilblains. A weak digestion, variable appetite, and torpid, or disordered bowels are also of frequent occurrence in such children; who nevertheless often display great aptitude and acuteness, lively imaginations, and ardent affections, and frequently a great precocity of intellect.

The scrofulous affection of the glands of the neck first appears as a slight swelling of one or more of the glands of one or both sides, especially of those situate beneath the lower jaw. The tumor is even to the touch, movable, and neither tender nor inflamed. Sometimes the swollen gland or glands will remain in this state without perceptible change for weeks, months

or even years; sometimes they gradually enlarge; sometimes coalesce, so as to form irregular knotty swellings; sometimes gradually disappear. In most cases they proceed to suppuration; fluctuation is perceived, the tumor points, the skin gives way, and pus, followed by a sero-purulent, mixed with a curdy or cheesy matter, is discharged by one or more openings. The abscess thus formed heals slowly, has an unhealthy appearance, a dull-red color, with hard, swollen, irregular edges, and an uneven base, clogged with curdy matter. After the ulcer has healed, an irregular and unsightly scar occupies its site. Though the superficial glands of the neck are those most frequently attacked, the deep-seated ones are often implicated; and the disease sometimes spreads along the course of the absorbents from one gland to another.

The constitutional disturbance which accompanies these local changes is usually slight. The patient retains his color, does not lose flesh, and has every appearance of good health. When, however, the local disease is extensive, and the glands suppurate, hectic fever sets in, with great weakness and loss of flesh. In advanced stages of the disease, especially in young adults, pulmonary consumption may supervene; the two diseases then run on together until they destroy the patient.

Causes.—*Predisposing.*—Hereditary taint; syphilis or gout, or a shattered constitution in one or other of the parents; disparity of age in the parents, or too near relationship; childhood, youth, and the early adult age. The disease is most common between the third and seventh year: comparatively rare after puberty, but may occur as late as thirty years of age. *Exciting.*—All causes of debility acting on the predisposed—such as sedentary habits of life; scanty and unwholesome food; the impure air of crowded and ill-ventilated nurseries, schools, workshops, and factories, and the confined rooms inhabited by the poorer classes; overwork; damp and low situations; exhausting maladies, especially fever, and the febrile exanthemata. The immediate exciting cause is often an attack of catarrh. The disease is common among prisoners.

Diagnosis.—From simple glandular inflammation, by the indolent character of the swellings.

Prognosis.—The disease, when limited to the absorbent glands, is rarely fatal, but tabes mesenterica, white swelling of the joints, disease of the spine, and pulmonary consumption are dangerous and fatal maladies. Scrofula is always tedious in its course, and uncertain in its duration.

Morbid Anatomy.—The glands contain a soft curdy matter, and the other viscera, especially the mesenteric glands and the lungs, tubercular deposits. The joints and bones are softened by similar deposits.

Treatment.—I. A nutritious diet, adapted to the patient's age, with a due allowance of animal food, and wine and malt liquors in moderate quantity. In scrofulous infants, brought up by hand, the substitution of the mother's milk, or of pure milk from the ass or cow. Daily exercise, short of fatigue. Warm clothing (flannel next the skin). Heavy clothing should be avoided.

Change of air, especially from a low, damp situation to a high, dry, and bracing one. Sea-air and sea-bathing in the summer and autumn.

A cold or tepid bath daily, followed by friction with a rough towel, or a shower-bath once or twice a week ; and gentle aperients at short intervals. A few grains of rhubarb, with small doses of hyd. c. cretâ may be given occasionally, followed by a tea or dessertspoonful of castor-oil the following morning.

Chalybeate tonics, especially the tinctura ferri perchloridi, the ammonio-citrate, and the dried sulphate, or quinine and iron in combination.

Iodide of iron in doses of from one to five grains, three or four times a day, and cod-liver oil (a teaspoonful three times a day gradually increased to a tablespoonful) are valuable remedies in scrofula.

II. Simple enlargement of the glands of the neck may be treated by the constant application of the emplastrum ammoniaci c. hydrargyro, or the frequent application of iodine paint. If the patient be at the seaside, poultices of sea-weed (the *Fucus vesiculosus*) may be kept constantly applied. Suppuration must be encouraged by poultices, and the matter let out by a small vertical or oblique incision. Caustic should never be used for this purpose, as it causes unsightly scars.

As open scrofulous ulcers have an indolent character, they must be treated by local stimulants, and in extreme cases by caustic. In treating other local affections in scrofulous habits, this indolent character must be borne in mind.

Remedies.—*Mercurial preparations given as alteratives*, such as Plummer's pill, or the perchloride of mercury (Form. 288). *Alkalies* and *alkaline earths*, of which the best is the liquor potassæ, in doses of from five to twenty drops, three times a day in some tonic infusion ; or from one to two drachms of lime water. The *mineral acids*, especially nitro-muriatic acid. The *chlorides of barium and of calcium*. (Liquor barii chloridi, ♏iii. to ♏v., cautiously increased ; or liquor calcii chloridi, ♏xxx. to ♏xl., gradually increased.) *Conium*.

In consequence of the slow and uncertain progress of scrofulous affections, many remedies seem serviceable which are really inert ; and it is so with pulmonary consumption, for which the most opposite remedies are confidently recommended and deemed efficacious.

RACHITIS—RICKETS.

Definition.—A distortion of the bones, occurring in infancy and childhood, from deficiency of earthy matters.

Symptoms.—The disease sometimes begins soon after birth ; more frequently when the child is five or six months old ; more frequently still before the close of the second year, after which age it is very rare. The rickety child is observed to be less healthy and strong than other children of the same age. The face is pale and the body thin.

Teething begins late, and goes on slowly, and the teeth soon become loose and carious. The fontanelles and sutures are usually open; the head, though smaller than usual, is generally large in proportion to the face, and the forehead prominent; the chest is flattened at the sides, and the sternum projecting; the epiphyses of the long bones become spongy, and the joints swell. This is commonly first perceived in the wrists and ankles. As the disease advances, the long bones yield to the weight of the body, and are twisted by the action of the muscles; the spine is curved and bent; and the pelvis distorted and narrowed. If the patient has begun to walk, the gait is unsteady and waddling. The mental faculties, except in cases of cretinism accompanied by distortion, are unimpaired, and even uuusually acute.

Causes.—*Predisposing.*—Hereditary tendency. A peculiar diathesis, allied to the scrofulous, but not identical with it; for enlargements of the cervical glands, and tuberculous deposits in the lungs, are not common in rickety subjects. *Exciting.*—Bad nursing, bad food, bad air, want of cleanliness.

Pathology.—Defective nourishment, or mal-assimilation of the food, leading to a deficiency of earthy matter in the bones. Dr. J. Davy found 100 parts of the dry tibia of a rickety child to be composed of 74 parts of animal matter, and only 26 of earthy salts. The microscopic appearance of rachitic bone is very characteristic. Ossification has taken place so partially and imperfectly that the bone is made up of isolated and apparently independent masses of unaltered cartilage, blended with completely and incompletely formed bone. Owing to the imperfect ossification of the matrix, the conversion of the enlarged cartilage cells into lacunæ is readily seen (*f* and *g*, Fig. 53).

Fig. 53.

Prognosis and Results.—*Favorable.*—The disease is very rarely fatal. In mild cases complete recovery often takes place, the swollen joints gradually returning to their natural size: in severe cases the distortion of the body is permanent, but the bones ultimately resume their normal composition, and even become more dense and compact than in persons originally healthy. Distortion of the pelvis endangers life by causing obstruction to parturition.

Treatment.—1. Food of good quality and adapted to the child's age is of the first importance. If the mother is delicate and cannot nurse, or the milk is poor, the child should be supplied with fresh milk from one cow. If this be not assimilated, a wet nurse may be provided. Dry and pure air, cold or tepid salt-bathing, with frequent frictions, and tonics, especially preparations of iron, such as steel-wine, the sulphate or potassio-tartrate of iron, form part of the treatment. Cod-liver oil may also be prescribed with advantage. Children living in large towns should be removed

to the country. The state of the bowels should be carefully attended to. In order to supply the defective bony constituents, from five to ten grains of phosphate of lime should be given three times a day, suspended in chalk mixture. Preparations of iron may be given at the same time. If the child be very weak, phosphate of ammonia may be given in lieu of phosphate of lime, in doses of from five to ten grains, three or four times a day; milk and lime-water in equal parts is a suitable drink.

2. The distorted limbs must be supported by such mechanical contrivances as do not interfere with the proper action of the muscles; and care should be taken not to allow the weight of the body to rest on those parts that show a tendency to swell or bend.

MOLLITIES OSSIUM—SOFTENING OF THE BONES.

Synonyms.—Osteo-malacia. Malacosteon. Atrophy of bone.

Definition.—Perverted nutrition of the bones resulting in rapid absorption of the earthy matter and consequent softening.

Symptoms.—These are very obscure, and the disease is rarely recognized till it has made considerable progress. Several and long-continued pains in the pelvis and lower extremities are apt to be mistaken for the rheumatic pains present in most cases; but the disease is generally recognized for the first time by a fracture occurring in some bone of the extremities on the application of slight force; by the bending, twisting, or distortion of one or other of the limbs; or, in females, by the increasing difficulty of parturition, arising from a growing distortion of the pelvis.

Anatomical Characters.—The cancelli of the bone completely absorbed, and the bone reduced to a mere shell, filled with medullary matter. The bones so softened as to admit of being cut with a knife. The periosteum sound. The teeth not implicated.

Causes.—*Predisposing.*—The female sex. It is comparatively rare in men. The adult age. *Exciting.*—Obscure.

Diagnosis.—From rachitis by the age of the patient; rachitis is a disease of infancy and childhood, mollities ossium of adult age.

Prognosis.—*Unfavorable.*—The disease often makes slow progress.

Treatment.—There is no remedy or treatment on which reliance can be placed. Our care must therefore be to improve the general health by nourishing diet, tonics, and such other medicines as are indicated by the existing state of the system.

PURPURA—SCURVY.

Synonyms.—Hæmorrhœa petechialis. Petechiæ sine febre.

Varieties.—1. *Purpura simplex;* 2. *Purpura urticans;* 3. *Purpura hæmorrhagica* (land-scurvy); 4. *Purpura nautica* (sea-scurvy).

1. Purpura Simplex.

Symptoms.—After slight uneasiness, or giddiness, an eruption of small rounded patches, of a dark claret color, on the thighs and legs and sometimes over the whole body. After a few days, the first patches fade, and new ones appear. The skin is readily bruised, and bleeding even from slight wounds is often difficult to control. There is little disturbance of the general health. The disease may last from a few weeks to as many years.

Pathology.—Capillary hemorrhage in the cutis occurring in isolated spots. Blood deficient in fibrin.

Causes.—*Predisposing.*—Peculiarity of constitution, debility. *Exciting.*—Febrile state of system. It is often attributed to cold.

Diagnosis.—By the shape and color of the spots, and the sound state of the cuticle.

Prognosis.—*Favorable.*

Treatment.—A nourishing mixed diet, and proper exercise, astringent chalybeate tonics, the mineral acids, and occasional mild aperients.

2. Purpura Urticans.

A form of urticaria, in which the patches are discolored by blood poured out in small quantity into the cellular tissue. (See *Urticaria.*)

3. Purpura Hemorrhagica—Land-Scurvy.

Symptoms.—Weakness, lassitude, and pains in the limbs, with a feeble pulse of variable frequency; petechiæ of larger extent than in the first variety; occasionally bullæ filled with liquid blood; gums swollen, livid, and spongy; hemorrhage from the gums, nostrils, uterus, and mucous membranes generally; rigidity of the legs from effusion of blood into the muscles; extensive bruises. In severe cases, all the symptoms of sea-scurvy.

Pathology.—A diseased condition of the blood; with defect or excess of fibrin; but in either case a want of power of coagulation. Hence a loose, rotten clot. The albumen is said to be so changed as to require for its coagulation a temperature 8° higher than usual.

Causes.—Those of sea-scurvy.

Sequelæ.—Ulceration of Peyer's patches. Falling off of the hair. Necrosis.

Treatment.—A generous mixed diet, with an allowance of wine or beer. Astringent tonics, chalybeates and acids. (Forms. 117, 129.)

Prophylaxis.—When scurvy occurs in prisons and workhouses, minute inquiries should be made as to the diet of the inmates. It may not be deficient in quantity or in the quality of the articles supplied; but the essential salt of vegetables containing a vegetable acid and an alkali, may

be absent. For instance, scurvy has been traced to the substitution of rice, which does not contain such a salt, for the potato, which does; and the restoration of the potato sufficed to banish the disease. As the cheapest and most easily stored vegetable of its class, the potato should always form part of the ordinary diet of prisons, workhouses, and hospitals.

4. Purpura Nautica. Scorbutus—Sea-Scurvy.

Symptoms.—Heaviness, weariness, dejection of spirits, aversion from exercise, dull pains in the limbs, especially at night; anxiety and oppression at the præcordia; palpitation and shortness of breath on the slightest exertion; a pale, sallow and bloated countenance; the skin in some cases hot, in others cold and contracted; the pulse in some cases infrequent, in others small and frequent; the tongue clean, moist, and pale; the gums swollen, spongy, and livid, bleeding upon the slightest touch, and at length separating from the teeth, which become loose; the breath offensive; petechiæ on various parts of the body; the slightest scratch degenerates into a foul ulcer; the slightest pressure produces a bruise, and old cicatrices open afresh, and discharge a thin sanious fluid; spontaneous ulceration likewise takes place upon the gums and on the surface; the joints become swelled and stiff; the muscles of the legs, and of the calf especially, rigid, contracted, and exceedingly painful; the bowels are either obstinately constipated, or there is diarrhœa; the urine is tinged with blood, or transparent, high-colored, and acid. Great emaciation ensues; passive hemorrhages take place from the gums, nose, and ears, from the stomach and bowels, and occasionally from the lungs and bladder; all the excretions become intolerably fetid; but the appetite frequently remains good, the patient retains his intellectual faculties, and talks with a loud voice, but is apt to faint on the slightest motion. Many patients expire as they are being carried ashore. Sudden death also may take place during some violent effort, and in extreme cases, from mere change of posture.

Causes.—*Predisposing.*—A cold moist atmosphere; sleeping in damp clothes or beds; the winter season; cold climates; fatigues and hardships; previous attacks of illness, especially of scurvy; indolence; depressing passions, and the general causes of debility; scanty supplies of water; deficient clothing; want of cleanliness; impure air. *Exciting.*—A diet restricted to a few articles of food, such as salt meat and biscuit; with deficiency of vegetable food, and especially of vegetable acids.

Diagnosis.—The absence of feverish symptoms, of cerebral disturbance and of contagion, and the presence of hemorrhagic spots and discharges, distinguish this state from fever and all other diseases. Scurvy, as it formerly occurred on land, in besieged cities, camps, and monasteries, and occasionally among entire populations, and as it now sometimes shows itself in prisons and workhouses, is essentially the same disease as that which occurs at sea.

Prognosis.—Generally *favorable*, if the previous health and strength were good, and if a proper vegetable diet, or other proper substitute, can be obtained. *Unfavorable.*—Where there is great prostration of strength; extreme oppression at the præcordia; red eyes and flushed countenance; a rapid weak pulse; profuse hemorrhages; dark-livid petechiæ of great extent; fetid and involuntary evacuations.

Treatment.—*Indications.*—I. To supply what is wanting in the diet. II. To palliate urgent symptoms.

I. The first indication is fulfilled by fresh vegetables, or fruits, as the orange, lemon, and lime; fermented and fermenting spirituous liquors, as ale, cider, and spruce beer, and the light French and German wines; sauerkraut and pickles; and for the very weak, punch, and the stronger spirits. At sea, ℥j. of lemon or lime-juice should be served out daily to each individual.

Occasional aperients of infusion of tamarinds, cream of tartar, or the sulphates of soda and magnesia, may be given, and the strictest attention must be paid to cleanliness and ventilation.

II. *Ulceration of the gums* requires astringent gargles of alum, muriatic acid, chloride of soda or of lime, or decoction of bark; or the steam of vinegar. *Acute pains* are relieved by opium; *oppression at the chest* and *difficulty of breathing*, by diffusible stimulants, such as nitric, sulphuric, or chloric ether with camphor; *contraction of the muscles of the legs*, by hot fomentations of vinegar and water, or emollient cataplasms, and by friction; *scorbutic ulcers* upon the surface of the body by slightly stimulant applications.

The *hemorrhagic tendency* and debility will be best combated by the free use of the mineral acids and chalybeate astringents.

Prophylaxis.—A due admixture with the food of fresh or preserved vegetables, or where these cannot be procured, lime-juice, lemon-juice, or citric acid. Also the acetate and bitartrate of potash. Among fresh vegetables, the potato and yam are the best. As a moist atmosphere is undoubtedly injurious, dry rubbing should be substituted for frequent washing in our ships. Cleanliness and ventilation should also be rigidly enforced; and mental inaction and despondency should be met by suitable employments and amusements.

RHEUMATISMUS—RHEUMATISM.

Varieties.—1. Acute. 2. Chronic. 3. Muscular.

1. Rheumatismus Acutus—Rheumatic Fever.

Definition.—Acute inflammation of the larger joints, usually shifting from joint to joint, attended by well-marked febrile symptoms; and in many cases, attacking the fibrous textures of the heart.

Symptoms.—The disease generally sets in soon after exposure to cold and wet, with all the symptoms of a severe attack of catarrh ; the pain in the back and limbs being unusually severe, and accompanied by a sensation of coldness and stiffness. In the course of one, two, or three days, inflammation shows itself in one or more of the larger joints, characterized by redness and heat of surface, acute pain, extreme tenderness, swelling, and tension. There is great constitutional disturbance, with extreme restlessness, intense thirst, and loss of appetite. The pulse ranges from 90 to 120, and is full, hard, and jerking ; the blood, drawn from a vein, is cupped and buffed ; the tongue is coated with a soft white fur ; the bowels are usually obstinately costive ; the urine is scanty and high-colored, has a strong acid reaction, but at this period of the disease is generally free from sediment. The skin is hot (102° to 108° Fahr.), and usually bathed in a profuse strong sour smelling sweat, which, however affords no relief. The fever and pain generally suffer an exacerbation at night.

The disease is rarely confined to the joints first affected ; but after some hours or days, attacks fresh ones, sometimes continuing unabated in those first seized, at others leaving them quite free from pain and swelling. In rarer instances, it returns to the joints first attacked, and ultimately extends to all the rest. Some amendment usually takes place in about a fortnight ; the pain lessens, especially at night ; there is less fever and perspiration ; the urine is more abundant, and lets fall a copious deposit of the mixed urates ; the appetite returns ; the thirst diminishes ; the pulse falls ; and the patient's movements become more free. Convalescence, however, is rarely interrupted, and the affection of the joints often assumes a chronic form.

In a large proportion of cases, the disease extends to the fibrous tissues of the heart, and the younger the patient the greater the liability to this affection. The symptoms which denote this formidable complication are dyspnœa, palpitation, and a sense of oppression, increased by pressure in the intercostal spaces, by inspiration, and by lying on the left side. In some cases pain in the region of the heart is present : the pulse is quickened, and has a peculiar thrill. As this heart-affection is often obscure, it should be sought after, and its earliest indications attended to. For the stethoscopic signs, see Pericarditis and Endocarditis.

Sometimes, too, the disease is complicated, and recovery retarded, by bronchitis, pneumonia, or pleurisy ; by inflammation of the brain and its membranes ; and by inflammation of the sclerotic coat of the eye ; diseases due to the rheumatic poison.

Morbid Anatomy.—Inflammation of the *fibrous* and synovial membranes of the parts affected, with effusion of clear or milky serum ; rarely of solid lymph. In the heart, the results of Carditis and Pericarditis.

Pathology.—This is essentially a blood disease, and consists of accumulation of uric, and perhaps, lactic acids. The blood also contains fibrin in large excess. The urine is very high-colored, and contains much uric acid.

Causes.—*Predisposing.*—Previous attacks. Youth. Debility. *Exciting.*—Exposure to wet and cold.

Diagnosis.—The pathognomonic symptoms of the acute form are inflammatory fever, with pains and inflammation of the larger joints, over which the integuments become distended, smooth, and of a peculiar pale-red color. Rheumatism may coexist with *variola* (see page 292).

From *Podagra* (see Podagra). From *Neuralgia*, by the history of the case; by the presence of inflammation and fever; and by the fact that in neuralgia the pain is generally confined to a single joint. From *Syphilitic periostitis*, by the extreme tenderness on pressure of the inflamed bone in that disease, the cranium, sternum, and shin, are the bones usually attacked; the previous history will also furnish aid.

Prognosis.—*Favorable symptoms.*—A general, but not too profuse, perspiration; repeated or continuous; sediment in the acid urine. *Unfavorable.*—Extension of the inflammation to the heart, chest, or brain. The disease is rarely fatal; but often leaves behind it organic disease of the heart, by which life is shortened; or chronic inflammation of the joints, with a great liability to future attacks. In favorable cases, and in persons otherwise of good constitution, the duration of the disease is from three weeks to a month, or six weeks, including the period of convalescence. Relapses are very common.

Treatment.—1. *General.*—As the system is saturated with acid, the most rational treatment is the alkaline, and it is the most successful. From half a drachm to two scruples of the bicarbonate of potash may be given, dissolved in half a pint of water, every three or four hours, or an ounce of lemon-juice with thirty grains of bicarbonate of potash dissolved in three ounces of water. The nitrate, bitartrate, and acetate may also be given with advantage.

Salicylate of soda proves to be most valuable in relieving the pain and reducing the temperature. It may be given in doses of 15 to 20 grs. with citrate of soda every two hours, and then, as the symptoms decline, every four hours.

The bowels must be kept free by saline purgatives, such as a Seidlitz powder, or from 40 to 60 grains of compound jalap powder.

Warm baths may be used with advantage before the pain has become so severe as to interfere with the moving of the patient. When the disease is beginning to abate, they may be used two or three times a week. Carbonate of potash or of soda may then be added to the bath in quantity to render it decidedly alkaline.

2. *Local applications.*—The affected joints should be enveloped in cotton wool. When the skin perspires profusely, and the surface is very hot, cloths dipped in an alkaline lotion (potassæ carb. ℥ ii., aquæ Oi) and covered with oilskin, may be substituted; or, if the pain be very acute and the patient restless, lint saturated with belladonna or chloroform liniment may be laid on the part. Blisters applied to the joints as they are successively affected, give great relief.

When the heart is affected, cupping, followed by blisters to the region of the heart, is indicated; or, if the patient be very weak, a blister alone.

2. Chronic Articular Rheumatism.

Symptoms.—This form may be a consequence of the acute, or may be independent of it. In the first case, the joints are left weak, stiff, and perhaps œdematous; and the pain, which was before shifting, is now confined to particular joints. Sometimes, however, it still shifts from joint to joint, but is not attended by acute inflammation or fever. Exposure to wet and cold often brings on an attack, which continues for a long time, and at length goes off leaving the affected joints weak and stiff.

Chronic articular rheumatism, when not a sequel of the acute disease, generally attacks the smaller joints of the hands and feet, and is then known as rheumatic gout.

Treatment.—When the disease is confined to one or two joints, leeches on every marked return or increase of inflammation; blisters near the affected joint, or even to the joint itself; and friction. When there is much effusion about the joints, or when the disease is more extensive, we must employ the general remedies recommended for the acute disease. The vapor bath is a most powerful remedy. The warm bath is of less efficacy, but the thermal mineral waters of Vichy, Aix-la-Chapelle, Karlsbad, Wiesbaden, Buxton, Bath, etc., have a high and deserved reputation in the treatment of chronic articular rheumatism. A warm climate also benefits cases that have arisen in a cold one, though warm climates are highly favorable to the occurrence of rheumatic affections.

Remedies.—Dover's powder in repeated small doses (gr. v. three times a day); vinum colchici (♏xx.) in combination with opium (tinct. opii, ♏v.); guaiacum, in the form of mixture, or ammoniated tincture; iodide of potassium (gr. iii. to gr. v.) with sarsaparilla (especially indicated where there is a syphilitic taint).

3. Muscular and Tendinous Rheumatism.

Varieties.—Some forms of this disease have distinct names; as *pleurodyne*, when it attacks the muscles of the side; *lumbago*, when its seat is in the loins; *crick in the neck*, when it affects the neck. Rheumatism of the muscles of the back of the thigh is sometimes, though incorrectly, called *sciatica*. The pain is sometimes limited to a particular tendon, such as that of the deltoid, or tendo Achillis.

Symptoms.—Pain, varying in character and severity, from a dull aching to the most acute darting pain, affecting the entire body, the trunk, a single limb, or a single muscle or group of muscles; coming on sometimes suddenly, at others after shivering and slight feverishness; often forming the most distressing features of a common cold and remaining after the other symptoms have vanished.

Prognosis.—*Favorable.*—The disease is free from danger, and does not affect the general health. Its duration may vary from a few hours or days to as many months or years.

Diagnosis.—The pain is increased by motion of the affected parts, by percussion with the points of the fingers, and by the sudden removal of pressure; but is relieved by firm pressure gradually applied. It is sometimes augmented, sometimes relieved, by the warmth of bed. From the severe pains in the chest and abdomen, which accompany spinal irritation, it is distinguished by the state of the spine. (See Spinal Irritation.)

Treatment.—By preparations of colchicum when recent and acute, and by those of guaiacum when chronic. The colchicum may be given in union with a mild saline aperient, and the guaiacum with alkalies. Opiate liniments, or blisters, may be resorted to in obstinate cases.

Prophylaxis.—Persons subject to rheumatism should wear flannel next the skin; protect the parts most liable to the disease; and avoid exposure to wet and cold.

Pleurodynia.

Pain in the left side is present in almost all the functional diseases of young and middle-aged persons; in dyspepsia, amenorrhœa, menorrhagia, leucorrhœa, hyperlactatio, and chlorosis, and in debility, however induced. In males it is equally common on both sides. It often accompanies chronic rheumatic pains of the joints or tendons. Acute pain in the side generally precedes by some days or weeks the appearance of shingles, and sometimes remains after the eruption has disappeared. (See Herpes zoster.)

Causes. *Predisposing.*—Debility. *Exciting.*—Overexertion, as in coughing; flatulent distension of the stomach; the rheumatic poison.

Diagnosis.—This is of great importance, though the disease itself is of little or none. It is distinguished from pleuritis, with which it is often confounded, to the detriment of the patient, by the absence of the constitutional symptoms of acute inflammation, and of the stethoscopic indications of pleurisy; by increased pain on motion of the affected parts, as in raising the arm, or twisting suddenly round, or by a sudden inspiration or expiration; by the effect of slight percussion with the points of the fingers; and by the immediate increase of the pain on the removal of pressure. The neuralgic pain preceding the eruption of shingles is usually very severe.

Complications.—With chest disease (for it is a common consequence of a cough); with acute dyspepsia; and with the diseases mentioned above.

Treatment.—If chronic, the emplastrum belladonnæ, e: opii, or calefeciens should be applied to the seat of the pain; if acute, a mustard-poultice. Symptomatic pleurodyne must be treated by removing its cause. When the affection accompanies rheumatism or gout, the treatment for those diseases should be adopted.

Allied to pleurodyne is an acute pain of the muscles of the abdomen or diaphragm, or of both together. That of the abdomen is apt to be confounded with peritonitis, as pleurodyne with pleurisy. The diagnosis is easy. Graduated pressure gives relief, except when a sudden expiration throws the muscles into action; but the sudden removal of pressure, percussion with the points of the fingers, and quick motion of the part affected, increase the pain. The absence of severe constitutional symptoms will assist the diagnosis, as will also the kind of respiration, which, in pleurodyne, is abdominal, in rheumatism of the muscles of the abdomen, thoracic. When the diaphragm is affected, the respirations are short and catching, and acutely painful.

Muscular rheumatism also attacks internal viscera, as the muscular texture of the heart, causing violent palpitation; the muscular coat of the œsophagus, giving rise to much pain in swallowing; and the muscular substance of the impregnated uterus leading to severe pains, similar to labor pains. Many internal muscular pains are connected with flatulence, or are symptomatic of dyspepsia.

Lumbago.

This disease affects the mass of muscles in the loins, and, when severe, confines the patient to bed, or prevents him from moving or walking without assistance, for the slightest motion is often agonizing.

Diagnosis.—From *disease of the kidneys*, by a normal condition of the urine, or yielding only the common deposits. From *lumbar abscess*, by the absence of rigors, and of hectic fever, and by the negative results of a careful examination of the part affected. [It should be borne in mind that collections of matter in the muscles of the back may *point* at the lower part of the back itself, at any part of the abdominal parietes, or below Poupart's ligament.]

Treatment.—The general treatment as in other forms of muscular rheumatism (see *supra*). The local treatment consists in the application of heat, an opiate or belladonna liniment, the emplastrum belladonnæ, e: opii, or e: picis, may be applied to the back.

PODAGRA—GOUT.

Varieties.—1. Regular gout; 2. Misplaced gout; 3. Atonic gout; 4. Retrocedent gout.

Symptoms.—The first paroxysm of gout generally comes on about two o'clock in the morning, with pain in the ball of the great toe of one foot (more rarely in the heel, ankle, or instep), accompanied by rigor, followed by feverish heat, and great restlessness. The pain increases till it becomes perfectly excruciating. The joint itself is exquisitely tender, so that the patient cannot bear the weight of the bedclothes, or the slightest jar or

movement in the room. The pain having attained its acme toward evening, ceases suddenly, or subsides gradually, about midnight; a general moisture breaks out on the skin, the patient falls into a sound sleep, and perhaps wakes free from pain. But in the majority of cases, on awaking next morning, the parts, which were before so painful and swollen, are found of a deep red color, tense and shining, the surrounding part œdematous, and the vessels turgid. For several days and nights the same round of symptoms recur, in a mitigated form, till at length the redness and the swelling subside, the skin desquamates, and the joint is either restored to its healthy state, or becomes the seat of the chronic form of the disease.

It rarely happens that one attack of gout is not followed, at a longer or shorter interval (sometimes of months, sometimes of years), by a second. Most patients, indeed, have several successive attacks, which at first occur at the same season of the year, but at length take place at all seasons, extending first to both feet simultaneously or in succession, then to the hands, and at length to almost all the joints. These subsequent attacks set in at all hours of the day and night, and commence in the hand or foot, in the great toe or thumb, in the knuckles, wrist, or ankle. They are attended with less pain, but with more constitutional disturbance. At length, after repeated attacks, the joints become deformed, stiff, and ultimately are the seat of accumulated chalky deposits.

The fits of gout sometimes appear without warning, but they are generally preceded by dyspepsia, with dejection of spirits, and irritability of temper; or by unusual coldness and numbness of the extremities, alternating with a sense of pricking or formication, frequent cramps, and unusual turgescence of the veins of the leg.

When the gouty diathesis does not show itself in inflammatory affections of the joints, it may appear as an affection of some internal part. If it attack the *stomach*, there is great depression and anxiety, followed by intense gastralgia, nausea, vomiting, and eructations, attended perhaps by pains and cramps of the trunk and arms. Sometimes there is obstinate constipation, sometimes diarrhœa. If the *heart* be attacked, palpitation, syncope, and angina are the symptoms present; if the *lungs*, dyspnœa, asthma, and sometimes a persistent spasmodic cough; if the *head*, headache and giddiness, followed sometimes by apoplectic and paralytic seizures; if the *spinal cord*, severe neuralgic affections, terminating in paralysis. These affections of internal parts, without inflammation of the joints, have been termed *misplaced* gout, or *atonic* gout, on the supposition that the system lacks strength to throw the disease out.

Sometimes the inflammation of the joints suddenly ceases, while the disease is transferred to some internal part. This is called *retrocedent* gout.

Pathology.—A blood disease, caused by excess of uric acid. The local symptoms are due to the deposit of crystalline urate of soda, in the inflammed part, both on the surface of the synovial membrane, and within the substance of the cartilages and fibrous tissues.

Uric acid is easy to detect in the blood of persons predisposed to, or

suffering from gout. Add six drops of ordinary acetic acid to ℥j. of the serum and suspend a thread of cotton in the mixture. After twenty-four or forty-eight hours, a string of minute rhombs of uric acid will be formed along the thread. (Garrod.)

Chronic gout sometimes results in one of the most inveterate forms of albuminuria, and the kidneys are found reduced to half their size and weight, shrivelled and granular, the cortex atrophied, and the pyramids streaked with white lines of deposited urate of soda (Fig. 22, p. 121), constituting the "gouty kidney," of Dr. Todd.

Causes.—*Predisposing.*—Hereditary taint. The male sex; the adult age (it seldom occurs before puberty, and in a large proportion of cases makes its first attack between 30 and 40); hereditary predisposition; plethora; a full diet of animal food; fermented and especially malt liquors; acid and acescent wines; a sedentary and studious life; dyspepsia. Gout is not peculiar to the rich, but attacks poor persons of temperate habits after long privation. *Exciting.*—Cold to the feet; fatigue; anxiety; excessive evacuations; sprains and blows; intemperance; a change from active to inactive life; suppression of customary evacuations, as of piles, which are common in gouty persons.

Diagnosis.—From *acute rheumatism*, by the solid nature of the effusion, by the affection of the smaller joints, especially the great toe, and by the more intense color of the inflamed part. By the absence of the profuse acid perspiration of acute rheumatism. Sometimes by the age; acute rheumatism being common in childhood, while gout is very rare before puberty. By the more rapid and complete convalescence. Gout occurs in free-livers of full habit, rheumatism mostly in the debilitated. The extension from joint to joint, and the heart affections so common in acute rheumatism, are less frequent in gout.

Prognosis.—*Favorable.*—No hereditary taint. Youth, and an unimpaired constitution; a first attack. The more severe the paroxysm, the shorter its duration. *Unfavorable.*—Hereditary predisposition, impaired constitution; advanced age, the deposit of chalky matter in the joints, endocardial thickening and irritation.

Treatment.—1. *General.*—An attack of gout may be effectually shortened by a full dose of the *Vinum colchici* (ʒj. to ʒij.), combined with opium taken at bed-time, and followed by a saline aperient in the morning; or, in a smaller dose (♏xx.) three or four times a day, combined with a saline aperient, according to the state of the bowels. After a time the saline diaphoretics may be substituted.

The exciting causes must be avoided by regular living, abstinence from fermented liquors, and the moderate use of animal food. After the acute symptoms have subsided, we may direct friction; regular and brisk exercise; Bath or Buxton waters, the use of mild aperients, the occasional use of alkalies to correct any tendency to dyspepsia. Salts of lithia promise to be useful in the elimination of the gouty material. (See Form. 266.)

2. The *local* treatment consists in wrapping the inflamed part in flan-

nel, wool, or fleecy hosiery; and in rest. Opium and atropia lotions may be used to alleviate pain.

Treatment of retrocedent Gout.—If the stomach be attacked, the application of a blister to the epigastrium: ether, ammonia, camphor, and musk, and sinapisms to the feet, with a view to restore the external inflammation. For other forms of retrocedent gout the treatment appropriate to idiopathic affections of the same organs.

Gouty Concretions.—Gouty concretions, or chalk-stone deposits, consist chiefly of urate of soda, and are deposited around the joints, in the bursæ mucosæ, in the cartilages, ligaments, aponeuroses, and connective tissue. The pain they occasion may be relieved by warm poultices, by rings of blistering plaster, above or below the swollen joints, or by iodine paint. An anodyne cataplasm or fomentation often affords great relief. Benzoic acid, combined with a salt of potash, in doses of a scruple about an hour after each meal; or benzoate of ammonia may be given and persevered in for a considerable period where extensive deposits have taken place. The waters of Aix-la-Chapelle, Vichy, Töplitz, Marienbad—all of which contain lithia—should be taken in lieu of spirits, wine, or malt liquors. Sometimes suppuration occurs around the chalky joint, and a foul chalky (*urate of soda*) ulcer results, which heals slowly and with difficulty. It should be dressed with rags moistened by a weak potash or lithia lotion, and covered with oil-silk.

END OF VOLUME FIRST.